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FEBRUARY 17th, 1944

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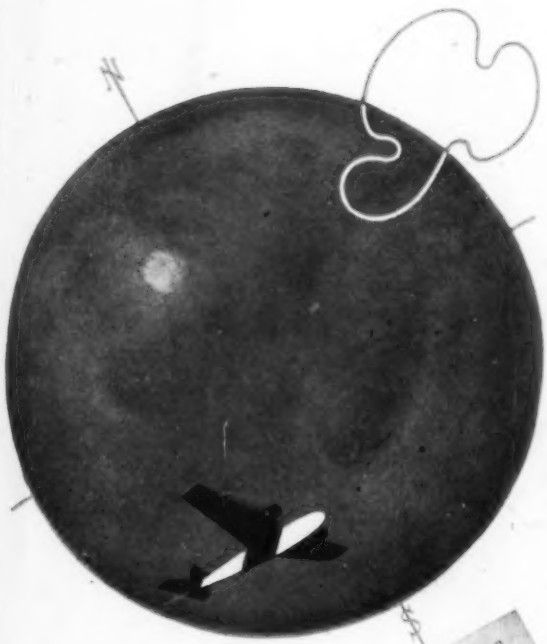

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First Aeronautical Weekly in the World : Founded 1909

Editor C. M. POULSEN

Managing Editor G. GEOFFREY SMITH, M.B.E.

Chief Photographer JOHN YOXALL

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The Outlook

The Ethics of Bombing

THE Bishop of Chichester is to be congratulated on having raised in the House of Lords the question of the ethics of bombing. To say that is not to admit that *Flight* agrees with all the pleas put forward by the Bishop, but we do think it was a good thing that the subject should be ventilated. The reply given by Lord Cranborne on behalf of the Government was quite unanswerable.

There are people who hold that modern war does not and cannot admit any rules of warfare. Total warfare, they say, is different in kind as well as in degree from ancient wars between professional armies. Civilians, according to this doctrine, all help the war effort, and therefore must be legitimately subject to attack quite as much as uniformed fighting men. This theory, however, does not really deny the necessity for rules of war; it only attempts to adapt them to modern conditions.

The Governments of the United Nations certainly cannot subscribe to the theory that because the Germans in this war and in the last broke many of the acknowledged rules of war, and in some cases were copied by the Allies, therefore all rules of war have become a thing of the past. The British Government has just invoked the Geneva Convention in the case of German and Japanese treatment of prisoners of war. That Convention was signed before air power counted in war, and so its application to air action can only be inferred from more or less parallel cases. As the Allies obviously intend to assert the validity of rules of war after they have defeated Germany and Japan, for the benefit of future ages, it follows that a new Convention is needed which will lay down what is and is not justifiable in the use of air power.

Analogies from artillery and naval bombardments in the past do not cover all the cases of air action, though they do suggest some guiding principles. Not long before the outbreak of the present war an international lawyer lectured to the Royal United Service Institution and stated that the existing law forbade armed forces to do anything which even endangered civilian life.

Such a rule, however, is impracticable. Mr. Spaight, in his series of books on the subject of air power, insisted that a rule of war, if it was to be respected, must not forbid to a belligerent his natural rights. If it did so, it would surely be disregarded by both sides, and so would cause all law to be contemned. A rule which was obviously reasonable, he argued, would be generally observed by both sides.

A Dangerous Argument

IN the present case of the bomber offensive against Germany, it is a dangerous line of argument to say that it will shorten the war, as the enemy could also use the same line to excuse all his enormities. It is also bad argument to say that the Germans began the air war on cities. Britain has publicly declared that her air action has not been undertaken as a reprisal, but that an air offensive, whenever practicable, had been part of our considered policy before 1939.

The main point is that the Germans have deliberately indulged in terror bombing on many occasions, of which Rotterdam was perhaps the most flagrant. There civilians were slaughtered in thousands for no military reason. The raid on Coventry can probably be excused because of the number of war factories in the place. The United Nations have never struck deliberately at civilians for the sake of breaking the enemy's *moral*. They have set out to destroy military objectives, and

not to kill civilians. That civilians have lost their lives in the course of these operations is regrettable; but such things must also happen when artillery shells a village in the Apennines. They happened also in innumerable towns and villages in the first world war.

"Things like that you know must be
In every famous victory."

Germany's Munition Supplies

THE Russian capture of Nikopol has struck a heavy blow against the German war potential. From that region, it is estimated, came a good half of the manganese which the Germans need for the production of steel. If one looks at a map of the lines in Russia one can see at a glance how the enemy held on to Nikopol as long as he possibly could, although the advance of the Russian armies to the north and the south left that city in a perilous position. Probably Hitler thought that it was worth while risking the loss of the divisions guarding the city in order to extract from it the last possible trainload of the precious metal.

It is inevitable that the German production of steel will suffer in consequence of this loss, and will probably take the form of using lower-grade steel for civilian uses, including the repair of the cities bombed by the R.A.F. The bombing offensive increases the German need for steel just at a moment when the Russian victory has seriously cut down the supply.

Another piece of evidence about German shortages has come to hand at the same time. The Polish officer who has recently made his way to England and has made a valuable report to Mr. Eden, has said that German officers talking openly in Warsaw restaurants have complained that their eastern operations were suffering more and more from shortage of oil and even of shells. The probability is that these were junior officers, and, if so, too much importance should not be given to their opinions. Taking the statement at its face value, it may mean that the German supplies are at last running seriously short, or that communications have been so interrupted that the supplies do not always reach the firing line.

Germany as a whole is not believed to be seriously short of oil, and for some time past neither Bomber Command nor the Americans have expended much effort on attacking oil installations. Shells are another matter, and if parts of the German eastern front have been short of them, we should incline to believe that transport difficulties have so far been mainly to blame. The railroads and rolling stock available to the Germans must now be in considerable disrepair, and the persistent hammering of engines and repair shops in Northern France by the R.A.F. must have done a good deal to make the position worse.

The bombing of Essen may also have reduced the output—it would be strange if it had not had that effect—and now the Germans must be trying to pile up a reserve of shells to meet the coming Allied invasion.

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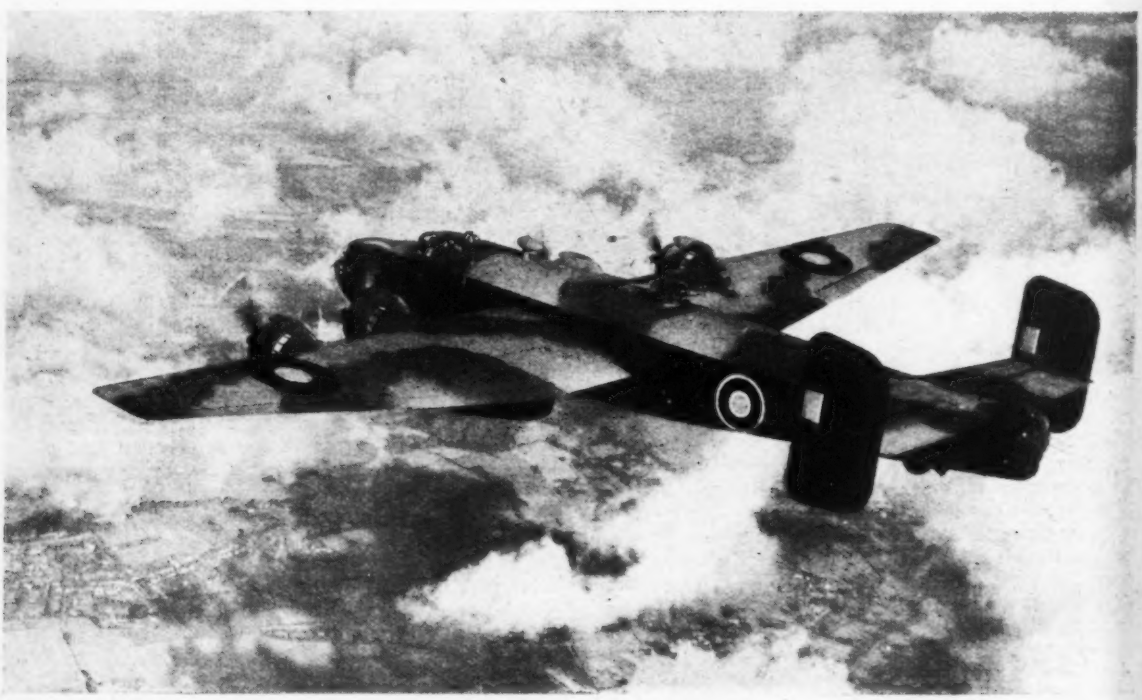


HANDLEY PAGE'S LATEST: The Bristol Hercules-engined Halifax III above the clouds. More photographs and some comments appear on pages 168-170.

The air battle as seen from one of a carrier task force off New Britain. In this action the Japanese had 64 aircraft shot down.

WAR in the AIR

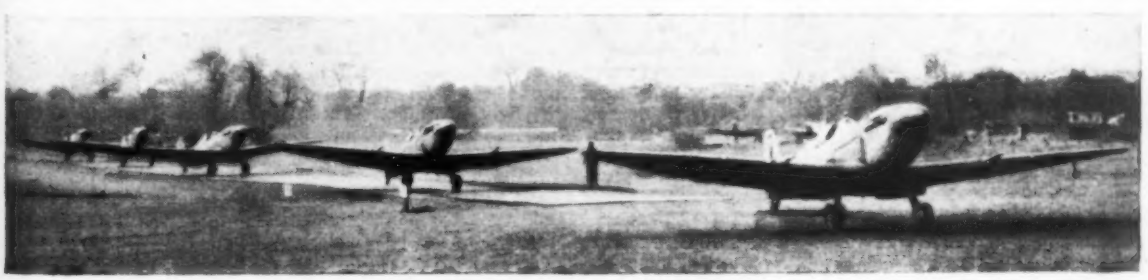
All Aircraft on Tactical Work in Italy : "Military Objectives" in France : Luftwaffe Fighters Coy and Bold

LAST week the enemy began to increase his air effort against the bridgehead round Anzio. It looks as if our policy there (for some reason yet to be disclosed) has been to invite attack against our position, instead of using it as most people expected that we should do for an offensive against the Germans. The small area round Anzio has been packed with so many troops that there does not seem room for any more, and the Germans have been able to move up big guns within range and shell the place. The probability is that they will have caused more casualties than it is pleasant to contemplate.

From the first the Germans have also taken air action, but not on an impressive scale. Up to February 6th their average performance was to send over daily about 30 fighter-bombers with an escort of 75 fighters. These sallies were not all directed against the bridgehead, but most of them were. The size of the escorts is evidence of the respect in which the enemy holds our Spitfires and other fighters. By night about 30 bombers used to come over and mostly attacked the shipping off the coast. Well-lit-up hospital ships offered the easiest targets. Since February 6th the enemy has increased the scale of his air offensive.

The position is that while the Allies hold a definite air superiority over the Germans, it does not amount to complete command of the air. The inferior side can still send machines over the battle area, and they can do a certain amount of damage. An inferior Air Force can often manage to do that much. It is significant that the enemy's bombers mainly confine their activities to the hours of darkness.

Some surprise has been expressed that, despite the great air strength of the Allies, the Germans have been able to move divisions about and reinforce parts of their lines. They have had much experience in working in the face of air superiority, and are now very adept at it. The movements are nearly all made by night, and railways play

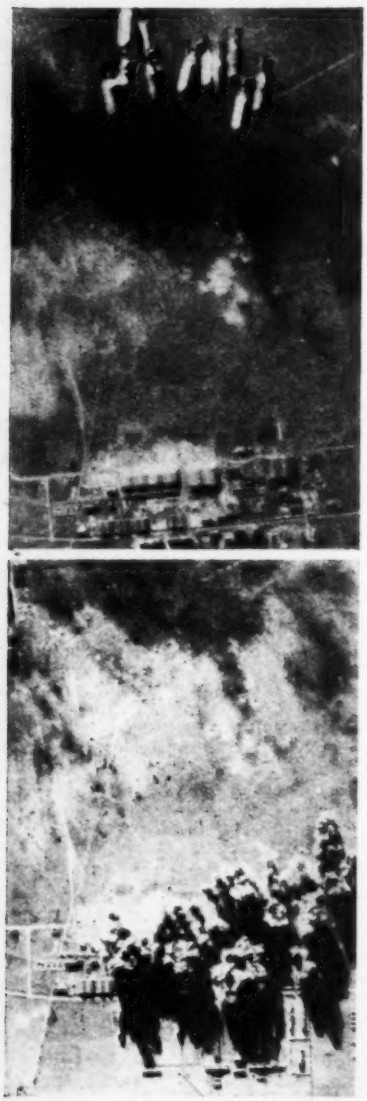


UMBRELLA MEN : Spitfires with pointed wing tips and Merlin 61 engines off to put height cover over the Anzio beachhead.

WAR IN THE AIR

only an inferior part in them. Most of the movements have been made by road, which uses up valuable fuel and helps to wear out transport vehicles. But the Germans have not yet been kept from achieving a purpose by shortage of fuel—except when Rommel's tankers were sunk during the victorious advance of the Eighth Army from Alamein. In Italy their supplies come by land and not by sea, which makes a big difference.

Clouds have been down to 3,000 feet, enveloping the tops of the Apennines, and they have naturally restricted the activities of the Allied heavy bombers. The Germans took full advantage of that. Though the American force of heavy bombers in the Mediterranean is under the supreme operational command of Gen. Carl Spaatz, who also commands the heavies of the 8th Air Force in Britain, while these operations have been going on in Italy the heavies there have joined with the Tactical Air Force in hitting at targets which are concerned with the campaign in Italy. There has been no disposition to take up the attitude "we are strategical bombers and have nothing to do with tactical work," which has sometimes hampered Allied results elsewhere. The sound policy has been followed of using all available air strength to help while a land battle is raging. Bombing an airfield in France from which the enemy might have sent machines against the Fifth or Eighth Armies is tactical work, even though it is carried out by a force which has been given the title of "Strategical."



BANG — ON THE TARGET: Two photographs showing some accurate bombing by the U.S.A.A.F. during an attack on a *Luftwaffe* training base near Chateauroux.

Flight has often preached that it would be folly to lose the battle of to-day through trying to win the battle of to-morrow. In other words, when there is tactical bombing to be done, it must take precedence of strategic bombing, and it is very gratifying to observe that our leaders have now taken that principle to heart.

The Daylight Offensive

IN the meantime the daylight offensive over Northern France has been going merrily on, and the term "military objectives" recurs almost daily in the communiqués. These have so far not been specified. The astonishing thing is that the Germans are making such feeble efforts to defend targets which obviously must be of importance. The fighting escorts which cross over with the Mosquitoes and Typhoon bombers are only too anxious to have a scrap with the Hun, but they do not often meet with him, and when they do he shows no great anxiety to engage in a dog-fight. No doubt the German fighter pilots are obeying orders in thus avoiding combat, for when a serious raid by heavy bombers crosses the coast, they attack it with quite reckless bravery and no little skill. This cannot be entirely attributed to the confidence which the Germans feel that their interceptor fighters are better than the escort fighters which accompany the American daylight raids. It takes a brave man to face the concentrated fire of the many half-inch machine guns in the Fortresses and Liberators, and the German fighters constantly face it, with heavy loss to themselves.

A notable case of such an air battle occurred last Thursday, February 10th,

BREECHES BOY: An armourer feeding belts of .303in. ammunition to the containers in the nose of a De Havilland Mosquito.

when U.S. Fortresses made another daylight attack on the aircraft works in Brunswick—the third raid on that city in a month. The bombers were escorted by Mustangs, Thunderbolts and Lightnings, and for two hours the Americans were fiercely attacked by between 200 and 300 German fighters. From the preliminary reports it appears that the Americans have now mastered the art of using their fighters to keep the enemy away from the bombers, at least to some extent. These early reports said that the escort fighters had shot down 55 enemy machines, while the bombers only claimed 29 victims. In earlier raids it was almost the invariable rule that the Fortresses claimed more victims than the escort fighters did. The quality of the American fighters is shown by the fact that only eight of them failed to return from the raid. Nevertheless, it was impossible for them to keep the German defenders completely at arm's length from the bombers, and 29 of the Fortresses were missing at the end of the day.

Eighth Armies

EIGHT, as a number for an Army, is one of ill omen for the Germans. The British Eighth Army drove them out of Libya, and now their own Eighth Army is surrounded by the Russians in the bend of the Dnieper, to the north of Shpola. Perhaps by the time these words are printed the end will have come. At the moment of writing the Russians have been closing in round the doomed ring, and have occupied all the important airfields in

ENEMY AIR LOSSES TO FEB. 12th

	Over G.B.	Continent	Middle East	Italy
Feb. 6	0	1	0	10
" 7	0	0	0	31
" 8	0	3	0	5
" 9	0	2	0	1
" 10	0	6	0	3
" 11	0	2	5	0
" 12	1	5	0	1
	1	19	5	51

Totals : West, 7,966 ; Middle East, over 5,819 ; N.W. Africa and Italy, 4,330.

the area. Those left in German hands are poor and very muddy. It is probably difficult to land a Ju 52 on any of them. One can picture for oneself how the Red bombers must be taking advantage of that situation to back up the Russian artillery by bombing the encircled Germans. They can meet with little opposition from German fighters, for there are all too few machines of that class in Russia for the German needs. Defending Brunswick is now thought more important than helping armies in Russia or Italy, or even the Pas de Calais.

Pacific Strategy

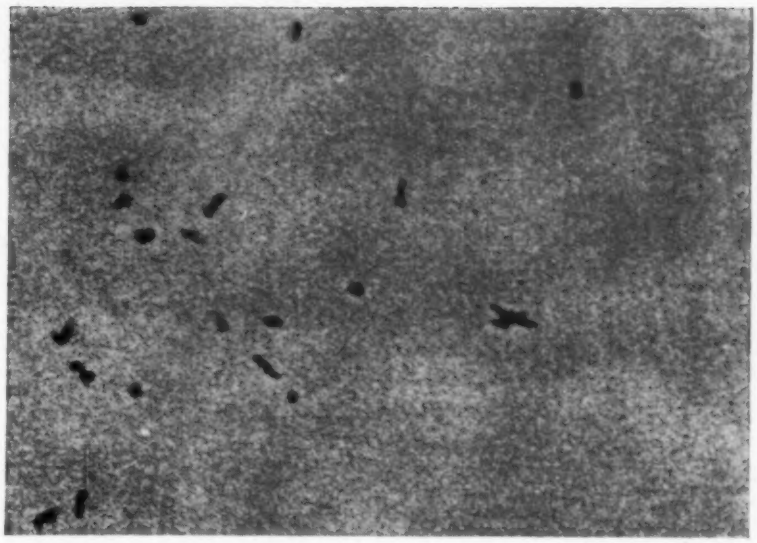
ADMIRAL NIMITZ has been holding some interesting Press interviews at Pearl Harbour. In one he declared that Japanese air power, and particularly naval air power, was now considerably below its peak, while the Japanese Navy was also short of destroyers. A day or two later he declared that the Allied object was to get our ground and air forces into China as soon as possible. We needed air bases there to raid Japan in the same way as Germany was now being raided. Moreover, it was necessary to cut off the supplies which Japan was getting from China, for without doing that we should find the Japanese difficult to beat.

In amplification of the statement made above that in the recent fighting in Italy all Allied bombers were used to give tactical support to General Alexander's armies, it has been explained that during the height of the German attack on the Anzio beachhead our heavies took part in the battle with good effect and brought relief to the British and U.S. troops.

As a general rule it is not considered good practice for heavy bombers to do the work of field artillery and operate too close to the battlefield. Their pressure should be exerted farther back behind the enemy's lines. Emergencies, however, call for unorthodox tactics, and one recalls cases (Bannockburn is said to have afforded one example) in which cooks and batmen have been thrown into the line as fighting men. But it is useful to remember that heavy bombs, designed for the destruction of buildings, are not so effective as the bombs of the mediums for dealing with personnel.

It is also instructive to read the comment of a correspondent of *The Times* at Algiers, who has surmised that we may have over-estimated the ability of our superior air power, Strategical and Tactical, to curtain off and isolate the battle zone. An official commentator in London has also said that the air could not be expected to isolate the battlefield.

It is necessary to win the battle of the air before one attempts to win the battle of the land. But the tendency to think that the air can do everything, and can relieve the Army of most of its responsibilities, only leads to disappointment.



GLIDER CARRIER : Anti-aircraft shells from Canada's first A.A. cruiser, H.M.C.S. *Prince Robert*, bursting round a glide-bomb-carrying Heinkel 177. It was one of 32 enemy aircraft which attacked a Britain-bound convoy.

BRITISH & U.S. AIR LOSSES TO FEB. 12th

	Over G.B. A'cft.	Continent B'brs.	Continent F'ters.	Middle East A'cft.	Italy A'cft.
Feb.					
6	0	5	6	0	13
7	0	0	2	0	5
8	0	14	11	0	0
9	0	0	1	3	3
10	0	31	10	0	6
11	0	5	20	1	0
12	0	1	1	0	1
	0	56	51	4	28

Totals : West, 9,711 ; Middle East, about 2,360 ; N.W. Africa and Italy, 1,613.

HOP, SKIP AND JUMP : A glide-bomb, dropped by the He 177 shown in the top photograph, missed the *Prince Robert's* bows and headed straight for a freighter. At the crucial moment it skipped over the freighter and exploded in the water 80 yds. beyond.

1. The two mechanics attending to the inner starboard Hercules give scale to the Halifax III.

2. This three-quarter rear view of the Halifax III shows the excellent fields of fire of the two 4-gun turrets.

Halifax De

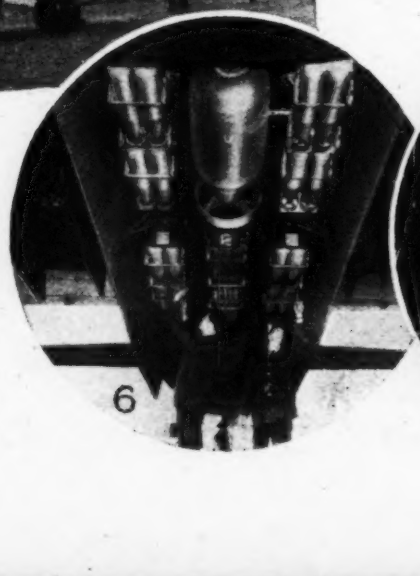
Hercules Engines in Latest Versio
Heavy Bomber : Benefits of I

IN accordance with the engine interchangeability programme mapped out as far back as 1938, the Mark III version of the Handley Page Halifax is fitted with four 1,650 h.p. Bristol Hercules XVI engines in place of the Rolls-Royce Merlins which powered the Halifax I and II. The increased horse-power has, of course, resulted in improved performance, but security reasons forbid us from publishing exact details.

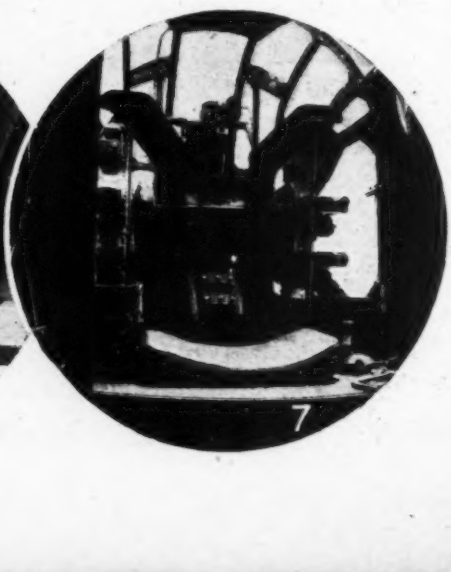
As would be expected, the take-off is improved and the rate of climb is better. The combination of the new engines and the addition of a further five feet to the wing span has stepped up the service ceiling by several thousand feet and, at the same time, the top speed has increased. The drag of the extra wing span has obviously been offset by the lower induced drag and the improved angle at which the new Halifax flies. This is one of the reasons for the greater speed.

Apart from the fitting of sleeve-valve engines there have also been several modifications to the defensive layout since the Halifax first went on operations early in 1941. The original Halifaxes had a two-gun turret in the nose, a two-gun dorsal turret and, like all our other heavies, a four-gun turret in the tail. The tail armament

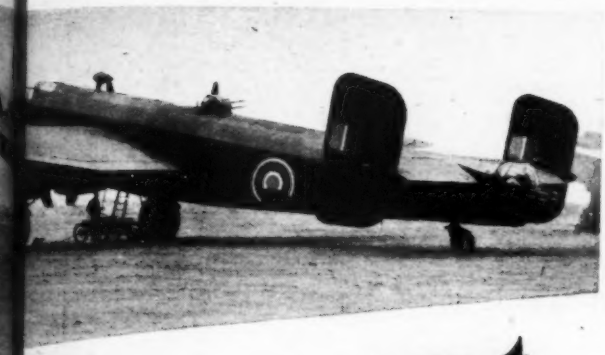
4. A glimpse under the stationary engines of one Halifax to watch another's engines being run-up



6. High-explosive and incendiary bombs stowed away in the capacious bomb bay.



7. The gunner's point of view. An internal photograph of the Boulton Paul rear turret.

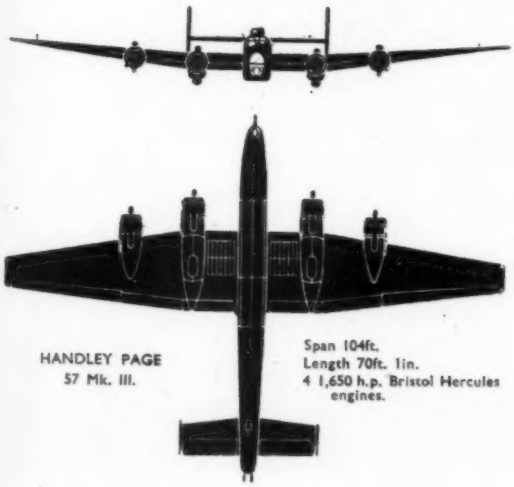


3. For comparison. An air photograph of the Halifax I which had a front turret, Rolls-Royce Merlin XX engines, and fins of smaller area.

lopment

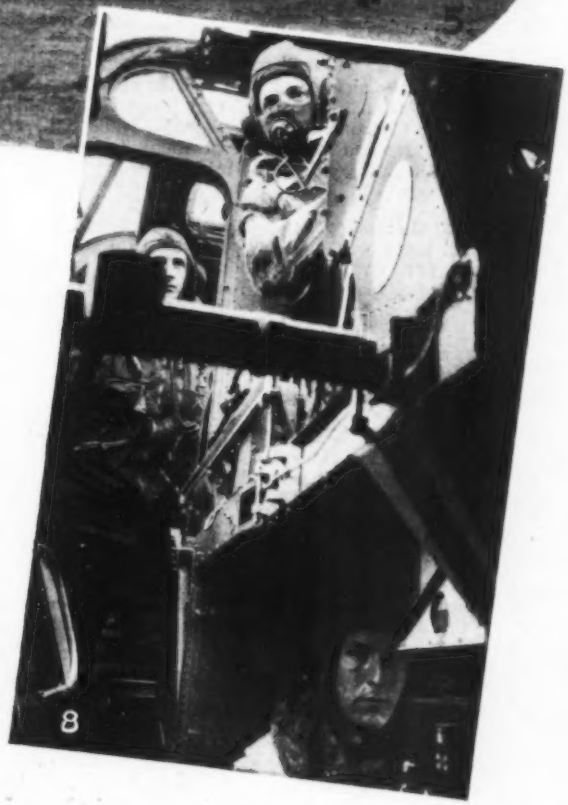
ndley Page
Span

5. The Hercules engines "fit in" nicely in the Halifax III and the whole presents a good-looking aircraft. Span is increased by 5ft. over the earlier Halifaxes.



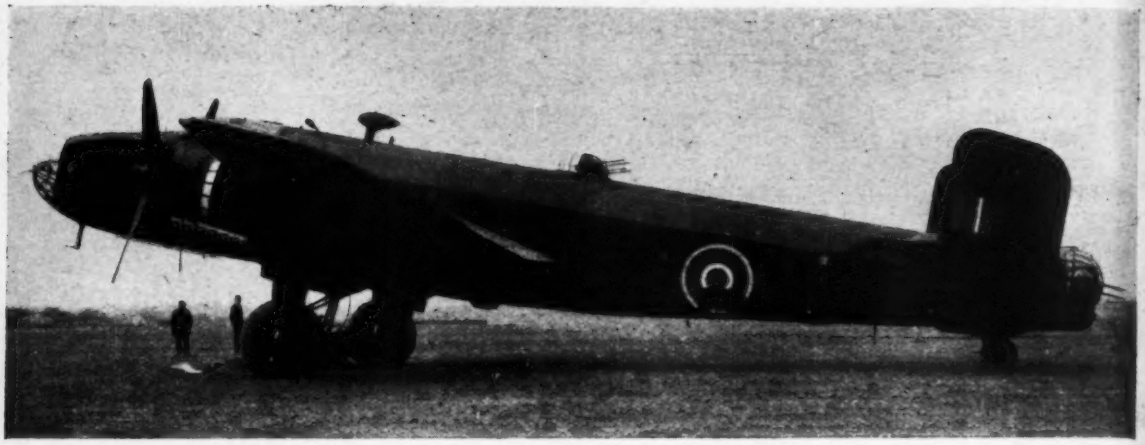
HANDLEY PAGE
57 Mk. III.

Span 104ft.
Length 70ft. 1in.
4 1,650 h.p. Bristol Hercules engines.



8. Relative positions. The navigator is on the same level but behind the pilot, while the radio operator is below.

has remained the same and the dorsal turret has been increased in fire power by substituting a Defiant-type four-gun turret to replace the Hudson-type two-gun turret. All the turrets have been the electro-hydraulically operated types manufactured by Boulton Paul, Ltd. Defensive armament in the nose always presupposes that head-on attacks will have to be warded off. It has been found that these head-on attacks do not materialise during night bombing, and it was felt that the heavy front turret, which takes so many man-hours to make, was unnecessary. In the Mark II it was therefore removed and replaced by a streamlined nose of transparent plastic material. There was also modification within a modification, however, in



Nicely proportioned, the Halifax III in its coat of night black looks every inch a modern night bomber. The new fins and rudders were fitted to the later Mark II, 1A Halifaxes, as well as to the Hercules-engined Mark IIIs.

HALIFAX DEVELOPMENT

that a number of the Mark I Halifaxes had their front turrets removed and replaced by a closed-in nose with small windows and a bomb aimer's panel until the fully transparent noses could be supplied.

In the Mark II and III there has also been some alteration to the twin fins and rudders. There had been a slight tendency to yaw which has been quite cured by the fitting of fins of different shape and larger area. These increase damping in yaw and so reduce excessive rates of yaw during violent manœuvres. Co-incident with the change of engines in the Mark III the airscrews have also been changed. The liquid-cooled Merlin XXs in the Marks I and II had Rotol airscrews with blades of compressed wood, while the Hercules engines transmit their power through De Havilland hydromatic airscrews with metal blades.

First in the Field

The name of Handley Page, Ltd., has always been associated with large machines. It was this firm which produced our first twin-engined bomber, the Rolls-Royce Eagle engined o/100, in 1915. A modified version of this, the o/400, dropped the first bombs on Cologne in December, 1917. Again, it was Handley Page who produced our first four-engined bomber, the V/1500, in 1918. The V/1500 was designed to carry a 3,300 lb. bomb (one of which type can be seen in the Imperial War Museum) to drop on Berlin. Only the end of the 1914-18 war saved the Berliners from having a foretaste of things to come a quarter of a century later. A few nights ago a force of Halifax IIIs bombed Berlin and 100 per cent. of the force returned. Thus is the best Handley Page tradition maintained.

An interesting sidelight on the Halifax design is that Handley Pages have in mind a commercial type which will incorporate many of the sub-assemblies of the Halifax. It is the proud boast of the concern that in the 40-seater H.P.42 of 1930 they produced the first really commercial air liner. Certain it is that in the H.P.42 hundreds of thousands of passengers were carried in comfort—and not one of them was injured in any way.

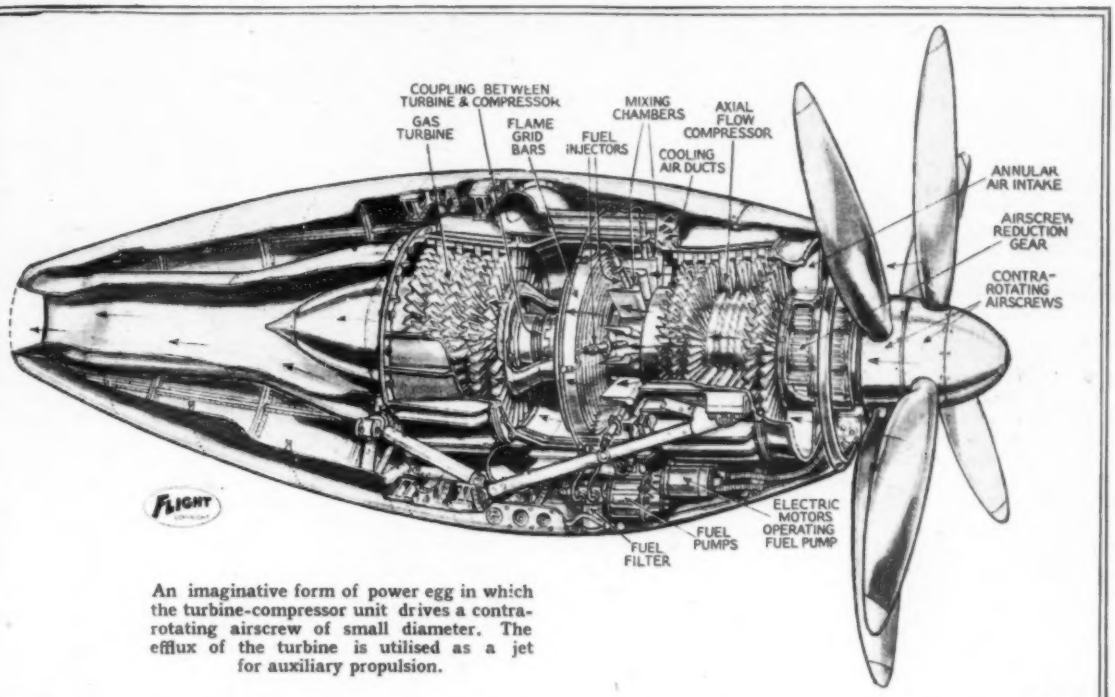
The air bomber has an excellent panel through which to operate his bomb sight.

NEW P-38 LIGHTNING IN ACTION

A NEW and improved long-range P-38 Lockheed Lightning fighter is already in action in the war theatres, the U.S. Army has announced.

Major improvements include: (1) A sufficiently increased range to make deep penetrations as a fighter escort on bombing missions; (2) a 30 per cent. increase in horse-power; (3) a radical increase in the rate of climb at altitudes of more than 30,000 feet and a materially increased rate of climb at all altitudes; (4) a greater level flying speed at high altitudes; (5) a ceiling raised to a point well over 40,000 feet; (6) a speed on single engine stepped up to about 300 miles an hour; (7) a greater improvement in combat manœuvrability due to mechanical aids for the pilot; and (8) the addition of unit power controls and automatic temperature controls to simplify the pilot's operational task.

The better performance is due mainly to the installation of an improved turbo-supercharger and new inter-cooler installations, boosting the twin Allison in-line engines to more than 1,500 h.p. each. Outwardly the Lightning remains the same. In addition, the new aileron booster, combined with the old-type combat flap, turns the plane into a dogfighter capable of out-manœuvring many single-engined aircraft.



An imaginative form of power egg in which the turbine-compressor unit drives a contra-rotating airscrew of small diameter. The efflux of the turbine is utilised as a jet for auxiliary propulsion.

JET versus AIRSCREW

Gas Turbine Power Plants of Great Potential Value : Consideration of Turbine Driven Airscrews

By G. GEOFFREY SMITH, M.B.E.

THE extraordinary amount of interest and comment aroused by the recent announcement that we are now producing jet-propelled fighter aircraft has tended to convey an impression that Group Captain Frank Whittle's invention is solely concerned with the jet propulsion of aircraft. Certainly that is its immediate importance, but, taking a long view, it has a much wider significance. It is the writer's belief that the outstanding achievement is the development of a small, light, continuous-combustion gas turbine as a practical prime mover alternative to the orthodox reciprocating engine.

The basic principle of jet reaction has been known for hundreds of years. Its utilisation as a means of propulsion for aircraft definitely marks an epoch and we have to thank Group Captain Whittle, working with Power Jets, Ltd., and British Thomson-Houston Co., Ltd., for developing it to its present practical stage. His patent of 1930 is of great historical importance, as in it, for the first time, it was proposed to apply the gas turbine to a jet-propulsion system. However, the potential value of a relatively small combustion gas turbine for aircraft, marine, railway, road transport and stationary duties, transcends in importance the relatively narrow application to jet propulsion.

In previous comments enough has been said of the admitted limitations of the four-cycle reciprocating engine, which by its inherent characteristics cannot conceivably attain the smoothness of operation of a perfectly balanced rotating mechanism such as a turbine. Neither would it seem possible for the reciprocating engine to be operated at speeds even approaching those which are quite practicable in a turbine. The lubrication of so many surfaces in rubbing contact and exposed to combustion gases may be mentioned as a further disadvantage. This, of course, is not to suggest that the turbine does not have its own peculiar lubrication problems, particularly that of feeding oil to shafts running at extremely high rotational speeds.

To produce a high-velocity jet of air to propel aircraft, the essential components of the power plant are an air compressor, a combustion chamber and a turbine. Exactly similar components may be proportioned and arranged to deliver mechanical energy to an airscrew shaft. The turbine plant can drive conventional tractor or pusher airscrews and the exhaust from the turbine can be utilised as an auxiliary propulsive jet.

Producing Mechanical Power

In the jet plant the turbine is virtually a subsidiary component, the sole function of which is to drive the largest possible compressor and thus deliver an enormous mass of air at high velocity. On the other hand, for a plant intended to produce mechanical power, the role of these two components is reversed. The compressor becomes what is in effect an auxiliary component, the function of which is to supply merely a sufficient quantity of air for the combustion of the fuel in order to produce a gas to drive the largest possible turbine.

It must be remembered that the useful power delivered by a turbine-compressor unit is much less than the power developed internally. To drive the air compressor, as much as 75 per cent. of the power of the turbine may be absorbed. To cite a practical example, unconnected with aircraft,

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we may quote the gas turbine locomotive of the Swiss Federal Railway. In this unit, comprising an axial-flow turbine and an axial-type rotary compressor and fitted with one heat exchanger to pre-heat the air delivered to the combustion chamber, the turbine develops approximately 10,000 h.p., but about 7,800 h.p. is absorbed in driving the air compressor. Thus only 2,200 h.p. remains for useful work.

Given a practical turbine-compressor unit, the functions can be varied within certain limits and will be determined by the duty for which it is intended. Thus, in the case of aircraft of the future, the conditions laid down for operation will determine, amongst other things, the form of propulsion to be adopted. Obviously, whether the duty is to be military or civil, long-range or short-range, high-speed or medium-speed, high-altitude or normal-altitude, and similar factors, will exercise an important influence on the ultimate choice. Eventually the criterion is not the specific efficiency of the power plant but the overall efficiency of the complete aircraft.

Thrust-Drag Ratio

The problem resolves itself into the thrust which can be made available to overcome the aerodynamic drag of the aircraft as it travels through the air. Due to its relatively small dimensions and light weight resulting from its high operating speed, the turbine may be conveniently submerged in the wings or fuselage of an aircraft, with an extremely beneficial effect on the aerodynamic shape of the structure. The aircraft can be smaller, lighter and of much cleaner outline with, of course, a consequent reduction of drag.

This improvement will apply in a different degree whether jet propulsion or airscrew propulsion is employed, but the advantage is more marked in the case of the jet-propelled machine. This factor is of such importance that, despite the lower thermal efficiency of the jet-propulsion plant as compared with a normal engine and airscrew, it is possible for a jet-propelled aircraft to have a better performance.

At low speeds and low altitudes jet propulsion has a relatively low efficiency. It follows, therefore, that due to the inefficient thrust of the jet at low speeds, the take-off and the rate of climb are not comparable with those of an aircraft employing an airscrew. To overcome this deficiency of thrust horse power when taking off from the airfield, thrust augmentors have been proposed. These may take the form of fans or screws to increase the mass of air passing through the plant.

Once a jet-propelled aircraft is airborne it can climb at high speed; but note that there is a difference between *speed* of climb, *rate* of climb and *angle* of climb. The efficiency of the turbine plant rises rapidly as the air flow through the blower and turbine is accelerated as the forward speed of the aircraft increases. Also, just as the thrust horse power rises with speed, the consumption of fuel tends to fall because the necessary mass of air for efficient combustion is now passing through the plant.

Since the rate of fuel consumption is particularly high at low speeds and low altitudes, there must be a limitation of the operating range of the craft unless useful load is reduced. These facts suggest that at the present and immediate future stages of development, jet propulsion will be confined to ultra-high speed, short-range aircraft or special high-speed craft operating at very great altitudes. One may deduce from such considerations that the advent of the turbine-compressor type of power unit challenges the reciprocating engine rather than the airscrew.

An airscrew is able to restore the thrust necessary for a quick take-off and a high rate of climb. It will be apparent that to apply airscrews to the new turbine-compressor unit suggests very interesting possibilities. In combination, they hold great promise for aircraft intended for operation at normal flying altitudes.

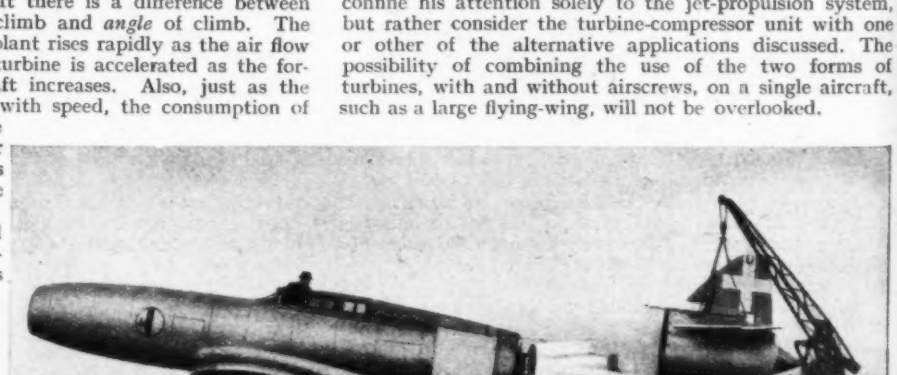
Factors Governing Selection

In the consideration of airscrews or jet propulsion of aircraft, the governing factors are speed, altitude, range and size of airfield for take-off. Decisions on these points are of paramount importance to manufacturers. Until airline operators have definitely settled upon their specifications of performance required, including speed, altitude, carrying capacity, degree of comfort and non-stop ranges, it will not be possible for either aircraft or engine manufacturers definitely to fix their plans for peacetime programmes. It is a long and difficult process.

In the light of present knowledge, what conclusions can be drawn from these observations? If large passenger transports with pressurised cabins flying at 500 m.p.h. at very great altitudes are the aim, then jet propulsion will almost certainly be employed. On the other hand, if opinion is confirmed that transports of the future will cruise at about 250 m.p.h. at the lower altitudes, which will not necessitate pressure cabins, then turbine-driven airscrews may well be chosen for propulsion. It must, of course, be presumed that the rate of fuel consumption can be improved as development work proceeds, and that metallurgists can assist by the production of better heat-resisting steels for the turbine blades.

An objection to the use of airscrews with turbines is that a rather complicated and weighty reduction gear becomes necessary due to the high rotational speed of the turbine—over 10,000 r.p.m. for example. The disadvantage should be reduced materially by the adoption of the counter-rotating airscrews, at present undergoing development and test. They furnish adequate blade area with a reduced diameter and could thus be operated at higher rotational speed without exceeding the permissible linear speed of the blade tips. They possess the further advantage of smoothing out the slipstream and consequently improving the air flow over the control surfaces of the aircraft.

Therefore, taking the long view of possible lines of development, the student of gas turbine design should not confine his attention solely to the jet-propulsion system, but rather consider the turbine-compressor unit with one or other of the alternative applications discussed. The possibility of combining the use of the two forms of turbines, with and without airscrews, on a single aircraft, such as a large flying-wing, will not be overlooked.



Hitherto it has not been revealed that the tail of the Campini jet propelled monoplane is completely detachable. The object appears to be to enable inspection of the effect of fuel burning in the annular mixing channel.

HERE AND THERE

Keeping Fit in the Factory

"HEALTH WEEKS" are to be held in all factories of the Rootes group for the benefit of their 40,000 workpeople. Sir William Rootes himself has inaugurated the scheme which includes a medical "Brains Trust" of eminent doctors to answer employees' queries on health subjects.

Three Instructional Films

THREE sound films, dealing respectively with the latest practices in machining riveting and welding aluminium alloys, have been obtained from America by the Wrought Light Alloys Development Association for loan to interested industrial and educational organisations in Great Britain.

The films have been specially prepared for the guidance of technicians and operatives in the light alloy industry.

Listen To-night

TWO U.S. fighter pilots are giving talks in to-night's B.B.C. Home Service programme at 6.30 p.m. One fought in the S.W. Pacific and the other up in the Aleutians, but both are now engaged in escorting day-bombers over Germany.

Maj. Jack Donaldson, D.S.O., Silver Star, D.F.C., calls his talk "From Bataan to Emden," and he will be followed by Capt. Delynn Anderson, who will tell about his experiences with a "Fighter Patrol in the Aleutian Islands."

The feature is given under the title of "American Flyers Against Jap and Nazi."

Egyptian Ambition

THE Egyptian Government intends to make Egypt one of the greatest aviation centres in the world, according to Sir Amin Osman Pasha, their Finance Minister, who said that a five years plan, which they intended to put into operation after the war, would guarantee work for all employees now working for the Allies.

Sir Amin was presenting Egypt's record £E70,000,000 budget which would, he said, be balanced without recourse to reserves. The increased expenditure covered the building of new airfields, the improvement of existing ones, and "the encouragement of aviation in Egypt."

The budget was approved by Parliament.

Ju 88 Gadgetry

A DECIDEDLY unusual "gadget" found on the Ju 88 captured in Cyprus and later flown to America is the device for getting rid of external bombs and wing-racks in emergency. The racks are secured by hollow bolts filled with explosive, and the touch of a button blows them off—without exploding the bombs, presumably! But why not a simple quick-release catch?

De-icing equipment takes the form of heated air from the engines led through ducts along the leading edges of the wings.

Comment is made on the functional adaptability of the design, but the "lack of meticulous machining in the engine housing and flight instruments" is a point of criticism.

DETAILS UNFOLDED: This picture of a Grumman Avenger discloses the details of its wing-folding arrangements. Fleet Air Arm pilots are being trained on Avengers in America.

The "York" for S. Africa

LAST week we quoted a statement from the *Rand Daily Mail* to the effect that the British Government was presenting General Smuts with "a giant Avro," costing some £100,000, as a token of its appreciation of his war effort.

Since then another statement has been issued on the authority of General Smuts which says that an Avro York has been ordered by the Department of Defence, and will remain the property of the South African Government.

"General" Smuts, of course, actually holds the rank of Field Marshal, but said, at the time of his promotion, that he would prefer to go on being called General Smuts.

To What (Air) Base Uses

LAUNCHED in 1939, the luxury liner *Pretoria Castle* is now an experimental aircraft carrier with the Fleet Air Arm—a sort of floating Farnborough where new equipment ranging from Mae Wests to the latest aircraft types are tried out.

When war was declared the *Pretoria Castle*, after only two voyages as a luxury liner, was converted into an armed merchant cruiser, but after a period of service in this role was recalled for her second conversion and became an aircraft carrier.

Representatives of the British and American aircraft and ancillary industries watch their products undergoing tests under active service conditions on her deck, and she was also used in effecting the standardisation of British and American signalling methods for deck landings and take-offs.

The First of the Many

FULL marks to the Leicester Wing of the A.T.C. for its excellent little booklet about the Air Training Corps in general and the Leicester squadrons in particular. This is attractively arranged and copiously illustrated with photographs, and should amply justify its newsprint allocation by its recruiting value.

When Air Comdre. J. A. Chamier started the Air Defence Cadet Corps, one of his closest associates in the project was Sir Lindsay Everard, of Leicester, and thus it came about that Leicester had the distinction of raising No. 1 (Founder) Squadron, which eventually became No. 1 (F) Squadron of the A.T.C. and the 1st City of Leicester Squadron. To-day the Leicester Wing boasts nine squadrons, namely, three city, one schools squadron, four district, and one for deferred service airmen.

Popular Fallacy

THERE is a widespread notion among the general public in Great Britain that practically every American town and city of any significance has an airport, and that civil aviation is a commonplace social amenity.

Actual figures recently given by the *Montreal Gazette* indicate how far this is from being the case, for of the 122 cities with a population between 25,000 and 50,000, only 52—less than half—enjoy a direct air service, while of the 413 cities in the 10,000 to 25,000 population category, the figure is 58, or fewer than one-seventh.

The war, of course, has multiplied the airfields, and by the end of 1943 there were 940 "suitable for U.S. transports," compared with 94 at the end of 1940. But the total in all categories is now 3,000 airfields, and according to C. L.

HERE AND THERE

Stanton, chief of the Civil Aeronautics Board, America should have 300,000 civil aircraft three years after the war and 500,000 ten years after.

B.A.L.P.A.'s Journal

THE LOG, official organ of the British Air Line Pilots' Association, made its reappearance with the January, 1944, issue; it is edited by Capt. D. A. Brice, whose offices are now at 7, Park Lane, London, W.1.

With the various activities now afoot, it should help to unite with the Home Country some of its distant executive councils who are as far away as Baltimore, Cairo, Durban and Montreal, and we wish it every success.

Butcher Bird

THE Curtiss A-25, which is the Army version of the SB2C Helldiver in service with the U.S. Navy, has been aptly named the Shrike, a small bird of prey which swoops down on its game with a smooth gliding sweep and takes it by surprise; the migrant or loggerhead Shrike is colloquially called the butcher bird.

The Curtiss Shrike has also been tested by the U.S.A.A.F. as a glider tug, which seems an unusual duty to combine with that of dive-bombing, if such is actually the intention.

Pan-American Fears

MR. JOHN C. COOPER, vice-president of Pan-American Airways, said in an address to the Foreign Policy Association: "It is a miracle that the entire air trade of South America was not fully dominated by Europe before the outbreak of the present war. If war had not come when it did, there would have been British airlines to South America."

There was no doubt, he declared, that European countries would again attempt to establish such lines. A few days later the following news item was issued.

British Air Service to S. America

BACKED by five British shipping companies operating sea routes to South America, the newly registered British-Latin America Air Lines, Ltd., has been formed with the object of inaugurating an air service to South America "as soon as the necessary consents and aircraft can be obtained."

Subscribers to the new company's memorandum and articles of association are Lord Essendon, Lord Vestry, Mr. W. H. Davies, Mr. J. W. Booth, and Sir Phillip Haldin.

The sanction of the British Government will be necessary in the first place to enable them to proceed with their plans, but the company points out that with their network of offices and agencies throughout South America the shipping companies concerned are in a strong position to foster the organisation and development of air services.

Faster and Cheaper

SPEEDS of 700 m.p.h. within the next few years were confidently forecast by Group Capt. D. F. Macintyre, a director of the Scottish Aviation Co., Prestwick, in a recent interview with Reuter. In fact he is quoted as predicting this speed "as a certainty" following on the development of jet propulsion for passenger-carrying aircraft after the war.

The experience gained in handling the wartime flow of air traffic, he said, would make it possible to begin commercial Transatlantic air travel almost immediately after the war, and travel costs would shrink as aircraft became larger.

ROYAL VISITORS: The King and Queen are shown the Operations Room by Air Chief Marshal Sir Arthur Harris during a visit to Bomber Command H.Q. Their Majesties also visited Pathfinder stations commanded by Air Vice-Marshal D. C. T. Bennett, and a station of the 8th U.S.A.A.F.

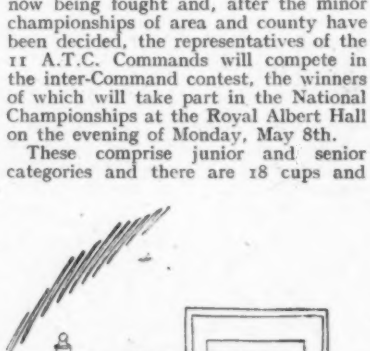
A.T.C. Boxing Finals

THE eliminating rounds in the annual A.T.C. Boxing Championships are now being fought and, after the minor championships of area and county have been decided, the representatives of the 11 A.T.C. Commands will compete in the inter-Command contest, the winners of which will take part in the National Championships at the Royal Albert Hall on the evening of Monday, May 8th.

These comprise junior and senior categories and there are 18 cups and trophies to be won in the various weight categories. Two of the cups are for the best losers in the semi-finals and finals.

As last year, *Flight* is presenting the cup for the winner of the Midget weight in the junior class.

A record entry has been received from all over Great Britain and Northern Ireland and tickets for the finals are already on sale at the Royal Albert Hall and from the Hon. Sec., A.T.C. Boxing Association, Air Ministry, Room 502, Princes' House, Kingsway, London, W.C.2.



Head Room for Seating

AT a small dinner and dance given to the senior staff of L. A. Rumbold, Ltd., a Canadian air-gunner guest made a plea for some upholstering on the armour plate protecting A.G.s' posteriors. A trip of eight or more hours, he said, made one wonder whether the protection was worth the discomfort.

Mr. Rumbold, who had been studying this problem for a long time, was quick in his assurance that the Rumbold company had spent a lot of time and effort on this problem. They had found, however, that the trouble was really lack of sufficient head room to incorporate thick cushions.

R.Ae.S. Lecture

ON Thursday next, February 24th, a lecture will be given on "Structural Features of German Aircraft," by Mr. D. M. A. Leggett, Ph.D., A.F.R.Ae.S., and Mr. H. Davison, before the Royal Aeronautical Society.

The lecture, which will be illustrated with lantern slides, is at 5.30 p.m., in the Lecture Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1.

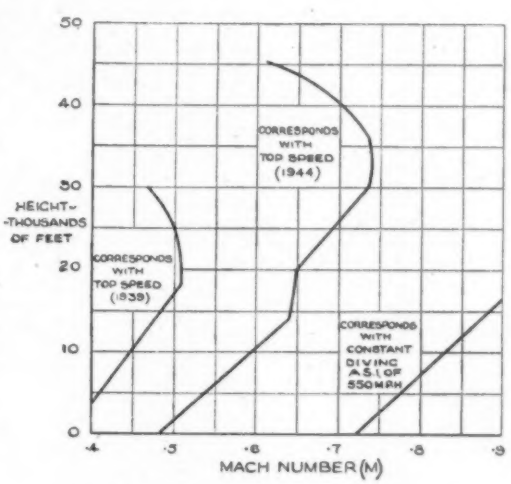
Non-members will only be admitted by ticket obtainable through a member.

Flight Testing

Difficulties Introduced by Modern High-performance Aircraft Flying at Great Altitudes

"WHAT will she do? Has she any vices?" These are the two questions which the young pilot is apt to ask when a new aircraft type has been produced. Just how vast is the labour needed in order to answer those two apparently simple questions was brought out very fully in the admirable paper read by E. T. Jones, M.Eng., A.F.R.Ae.S., before the Royal Aeronautical Society last Thursday. The paper deserves to be read in full by everyone seriously interested in his subject, which was: "Flight Testing Methods." Unfortunately the complete paper would occupy some 30 pages of *Flight*, so we hope our readers will forgive us if we confine ourselves to a mere outline of the numerous subjects with which the lecturer dealt. Later, when the paper is published in the Society's Journal, many will be able to study it there.

Mr. Jones began by pointing out the difficulties introduced by the fact that in moving through the air an aircraft sets up local pressure and velocity fields around it. The pressure contours within this field become steeper in gradient as they approach a part of the aircraft, and they change with wing incidence, with the shape of external components, and with the Mach Number, which is the ratio of aircraft speed to the speed of sound at the particular height at which the aircraft is flying. We reproduce herewith a graph which shows how the Mach Number has jumped between 1939 and 1944. The speed of sound, it might be pointed out, decreases with height, and the graph shows that in 1944 we have reached nearly 75 per cent. of that speed at about 35,000ft. Locally, speeds well above the speed of the complete aircraft may be reached, and some recent fighter aircraft have shown symptoms of this "compressibility effect," and in some cases recovery from dives has been difficult.



This graph, height plotted against Mach Number, indicates the jump in performance and height between 1939 and 1944.

The scope of flight tests is in general limited to determining the characteristics and "safeness" of the aircraft, and the data required by the operator to enable him to determine fuel and pay load for a given range, and journey time at selected speed.

Flight Tests Required

Flight tests required to establish performance and behaviour were classified by the lecturer under four groups: complementary tests, performance and allied quantitative tests, tests for flight characteristics, and miscellaneous tests. In the paper each of these four groups was given a separate part. The wide scope of the paper will be realised from the subjects in each group. They are as follows: In group I, measurement of air temperature; difference between atmospheric pressure and pressure at the static head. In group II: take-off; measurement of speed; max. speed-height curves; cruising speed-height curves; minimum speed for continuous cruising; partial (or saw-tooth) climbs; ceiling climbs; range; cooling tests of engine installations; landing and approach. In group III: take-off; longitudinal, lateral and directional trim; longitudinal, lateral and directional stability; longitudinal, lateral and directional control; stability and control at the stall; spinning; steadiness in controlled flight; behaviour with one or more engines cut; manœuvrability; dives; the baulked landing; determination of acceptable c.g. limits. In group IV: cabin and gun heating; cabin contamination; noise; structure.

Take-off distance and distance to clear a 50ft. screen are measured by means of the F.47 camera, which is virtually a phototheodolite.

Speed, excluding the stall region and gliding flight, is measured by registering the differential pressure between the pitot and static pressure heads. The lecturer explained in detail the troubles introduced by position errors and the means adopted for assessing or overcoming them. He made the interesting disclosure that some improvement is likely to follow the decision to replace the normal underwing pitot static heads by a leading-edge pole projecting approximately half a chord length ahead of the wing leading edge. In America, Wright Field had made a success of the use of calibrated aircraft formating the machine on test, but this method was uneconomical in aircraft, in this country. Radio ground-speed equipment might be used after the war, but at present there is too much interference.

Stalling speed is determined by flying level at best climbing speed, closing the throttle slowly and at the same time gradually moving the control column backwards. A speed is reached at which the nose or one wing can no longer be kept up, and this speed is taken as the stalling speed. For great accuracy the static pressure head is suspended below the aircraft, clear of the pressure field, and a swivelling pilot head is placed away from local interference.

Gliding Flight

Speed in gliding flight is determined, for multi-seaters, by the use of a trailing static head or trailing air log. In single-seaters the easiest method is flight in formation with a calibrated aircraft.

Full-speed tests at altitude present the difficulty that the full-throttle period for the engine is limited to five minutes, and it takes longer than that to reach top speed from cruising speed. The solution is for the pilot to obtain first at each height the approximate A.S.I. before the proper test is made. He will then make his approach from cruising speed to top speed by increasing speed and losing height as he gradually opens the throttle. As he approaches the pre-determined A.S.I. he will have regained level flight with the throttle fully open. The readings of the instruments are then taken during the last two minutes of the five-minute, full-throttle period

Speed-height tests for maximum cruising power are more easily made because each run can be maintained to ensure stabilised speed. Near the ceiling patience is required, particularly as the ratio cruising power to weight decreases.

Engine powers and airframe characteristics are not entirely consistent, so that what is needed is an easily fitted torquemeter. Information is also needed concerning the effect on speed of external surface finishes, and a method of categorising the finishes.

In long-range operations a knowledge of the minimum speed for comfortable continuous cruising is of great importance. It has been found that this speed is most reliably determined during cruising speed and fuel consumption measurements. A good approximation to minimum speed for cruising is 1.35 V_{imp}, where V_{imp} is the speed for minimum drag power in level flight. Cruising ceiling may be assumed as the greatest height at which the speed 1.35 V_{imp} can be maintained at maximum cruising power.

Before measuring climb to ceiling it is necessary first to determine the A.S.I. for the maximum rate of climb by making

FLIGHT TESTING

partial or "saw-tooth," climb tests. To determine the best climb performance it is necessary to know the best climbing speed at all heights from ground level to ceiling. The procedure found best when an observer is carried is to obtain steady climbing conditions at the chosen speed, and then to read a Kollsman altimeter at ten-second intervals over the selected height range. The required speed range should be covered systematically up and down, i.e., the range 120-160 m.p.h A.S.I. should be covered in the order 120, 130, 140, 150, 160, level, 160, 150, 140, 130, 120. On fast-climbing single-seater fighters an "automatic observer" is now being carried, which records the many data which the pilot cannot possibly note during the tests.

Partial climbs with one or more engines "dead" follow much the same procedure as with all engines working, but it may be necessary to continue each run for a longer period of time.

Having determined, for all heights, the speeds which give the maximum rate of climb, the climb to ceiling is made, using the maximum climb power and the best climbing speeds.

Before a range flight can be made, accurate measurements are required of the fuel flow over a wide range of power and flight conditions. From these results, suitably corrected to standard conditions, the specific range in air miles per gallon at each of a large number of combinations of the factors involved is obtained. From this, in turn, the optimum conditions can be selected and the maximum operating ranges in still air determined. An actual range flight is then required as a practical check on the ideal range. Fuel flow is measured by the Kent flowmeter, which comprises two units, a transmitter installed in the last fuel pipe to the carburettor, and a receiving unit in the cockpit.

The actual range tests vary with aircraft types, but, in general, a series of runs is made in each supercharger gear at a height slightly below the full-throttle height for maximum weak-mixture cruising conditions. Fuel flow and speed are measured at all combinations of r.p.m. and boost in steps of, say, 100 r.p.m. and 1 lb./sq. in. boost. Tests are mainly made using weak mixture, but a few are made with rich so as to decide the losses incurred by the use of rich mixtures, the consumption under combat conditions, etc. The results are then plotted in the form of air miles per gallon against an A.S.I "grid."

Tests of the cooling of engines have occupied more flying time at the A. and A.E.E. than other tests because definite requirements have to be met in definite conditions of flight. The effectiveness is determined from observations of temperatures.

That part of the lecture which dealt with the determination of flight characteristics, or, in other words, "behaviour," cannot usefully be summarised, but the following tribute, paid by the lecturer to our test pilots, deserves to be placed on record: "All the world knows of the excellence of some of our types operating to-day, and I am happy to have this opportunity of suggesting that a large slice of the credit should be given to the test pilots of the past."

Mr. Jones expressed the view that the test pilot still plays a large part in the assessment of the behaviour of new types, and in the accuracy of many of the performance results. His influence over the latter would be reduced by the more extensive use of recording equipment, but over the former it would remain and even increase. If we were to keep up the present excellent all-round standards, the test pilot's knowledge and experience must keep pace with designers. As a first step towards ensuring this, a school for test pilots had been founded at the A. and A.E.E.

The aircraft on which these pilots will be required to make certain tests will be fitted with special instruments. A modern aircraft in which the fin area and the wing-tip dihedral could be varied in flight would be of immense help in making possible a study of the interaction of lateral and directional stability in actual flight.

Two items of equipment which would be a boon were the Desyn system of remote indication of control-surface angles and forces, and the electrical resistance strain gauge for the measurement of steady stresses in structures.

BOOK REVIEWS

Aircraft of the Fighting Powers, Vol. IV. Compiled by H. J. Cooper and O. G. Thetford, and edited by D. A. Russell. Harborough, £1 1s.

THIS attractively presented book lives up to the standard set by its forerunners and forms another annual instalment in what is virtually a chronological record of military aviation during World War No. 2. It deals with 16 British, one Canadian, 47 American, 10 German, one Russian and one Japanese aircraft, according the same amount of space to every one. In spite of present-day obstacles (of which "security" is not the least) this book gives a surprising amount of information and achieves a laudable degree of accuracy.

"Pathfinders," by Cecil Lewis. Peter Davies, Ltd. 9s. 6d.

IN this book the author of *Sagittarius Rising*, for two decades unrivalled in its particular field, has written another classic, which takes up a complementary position by the side of its subjective companion. There is no question of rivalry; each is self-sufficient, self-contained, and of its temporal kind perfect.

In *Pathfinders*, Lewis has exercised his gift of character drawing to such effect that it is with a sense of shock one continually is drawn back by an unrelenting mind to the inescapable fact that these men are dead. Yet they live; you live with them; you cannot help experiencing coevally with them their various lives, their hopes, fears, despondencies, and struggles. The author's powers of description, abstract and concrete, are wielded with so sure a touch that the habit of one's own existence is put aside and donned again only with reluctance.

An aura of authenticity illuminates these pages, and the pen pictures delineated conjure in the mind a personal association that mocks the vicariousness of the feeling experienced.

The treatment of this book is beautifully simple. You are introduced, at their Station, to the six men who form the crew of the Wellington, "P" for Pathfinder; you are briefed, climb aboard with them and take off. During the flight to Kiel you raise the curtain that shrouds the privacy of these men, one by one, and live with them their tiny lives.

So rarely is it that a man, who, being fastidious in his tastes for reading and having with that quality an impatience for technical inaccuracies, can be really satisfied with a book that has a setting indissolubly wedded to technicalities. So rare, and yet Cecil Lewis writes of Italy, Canada, Hampstead, New Zealand and a London slum with a facile ease that is never at variance with the accuracy of his Service and flying descriptions. More, he knows the sea; there is a personal touch about the Pacific hurricane that verifies the written word.

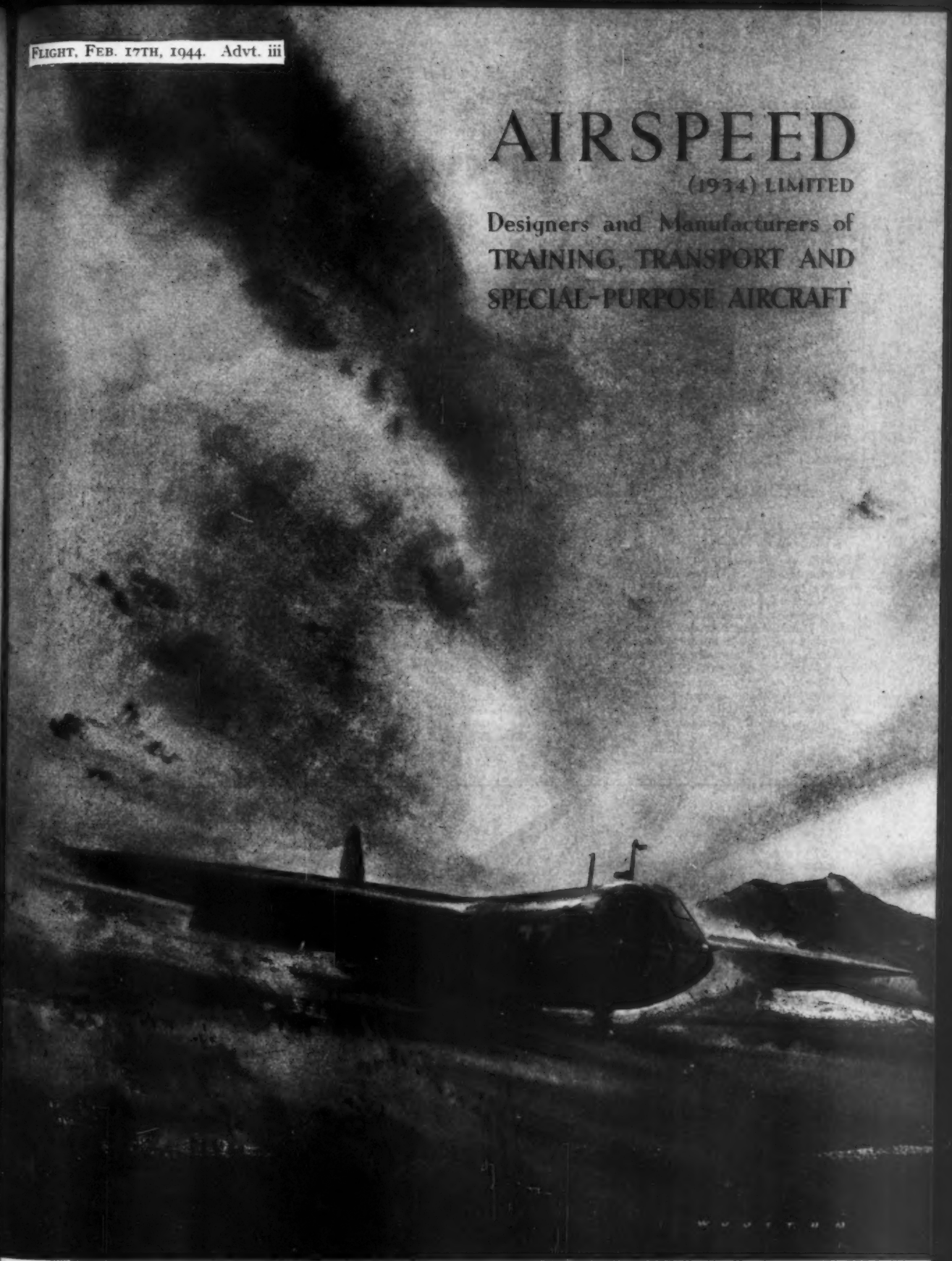
Viewed collaterally, *Pathfinder* is not in the same sphere with contemporary literature dealing with the Royal Air Force, its work, or personnel. It is a constellation with its own orbit. The fact that the unifying conditions are those of a bombing force pathfinder is supplementary in importance to the main theme, yet that quality alone places the book ahead of anything yet written on the same foundation.

The Birth of the Royal Air Force. By Air Commodore J. A. Chamier, C.B., C.M.G., D.S.O., O.B.E. (Pitman) 15s. net.

AIR COMMODORE CHAMIER explains in a note that he became impressed with the fact that the official history of the first world war in six volumes was only suitable for serious students, and that there was room for a more concise history. He was certainly right. He has, however, not been content merely to record facts in an abridged form; he has ventured on criticisms of how the R.A.F. and R.N.A.S. were used in the war. He has no good word to say for the Admiralty in its handling of the R.N.A.S., and he is equally frank, though his words are more restrained, in criticising the strategic and the tactical handling of the R.F.C. He himself might be criticised as being wise after the event, but he makes the reader share his surprise that many things were not done differently.

All through the book Air Cmdre. Chamier preaches the principle of concentration of effort, and shows by innumerable examples how this was persistently ignored throughout the last war. As a result he concludes "that there is no direct evidence that all our bombing and all our ground attacks between 1914 and 1918 altered by a hairsbreadth the course of the war on the ground." It will be observed that air reconnaissance is not included in this condemnation. Also, he makes an exception of Palestine, where aircraft destroyed an army in a defile.

Of the air fighting policy he writes: "The doctrine of the offensive, associated for ever with the name of Trenchard, was the correct one from the point of view of morale as well as of material results, but an active offensive in the air at all times and places regardless of need or object was a stupidity for which we paid dearly in lives."



AIRSPEED

(1934) LIMITED

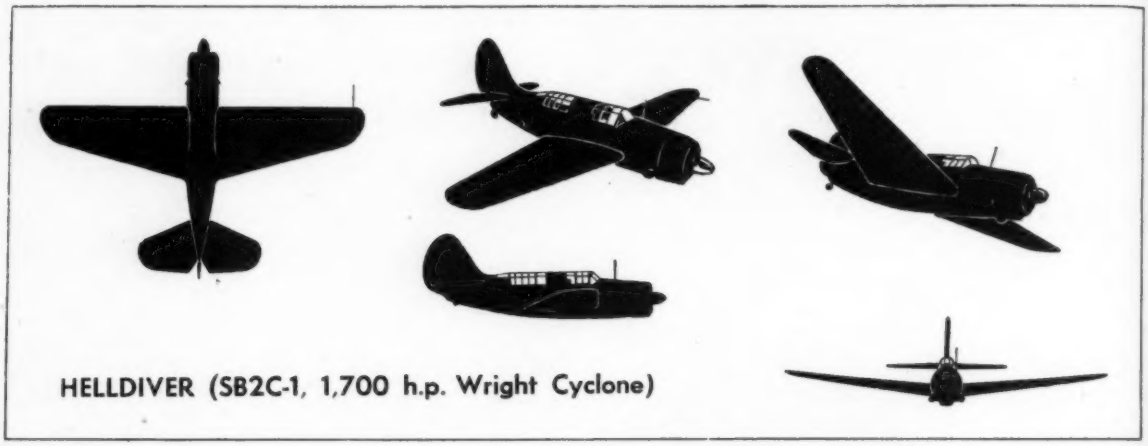
Designers and Manufacturers of
TRAINING, TRANSPORT AND
SPECIAL-PURPOSE AIRCRAFT

Invasion tactics involve glider landings—even by night—in the most difficult places such as Frank Wootton envisages in this fifth sketch of the HORSA *in operation*

IT was their long and wide experience in catering to the needs of commercial aircraft operators which enabled Airspeed to attack with enthusiasm the problems of the towed transport. HORSA, now standard with British airborne forces, was the conspicuously successful outcome of that specialised knowledge

Studies in Recognition

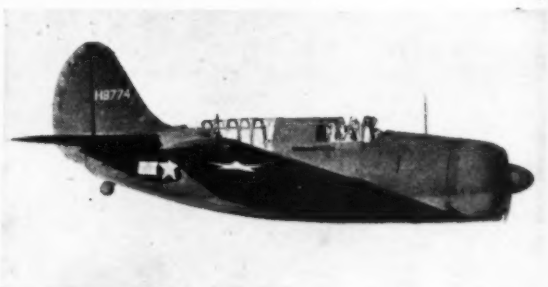
Aircraft in Fi



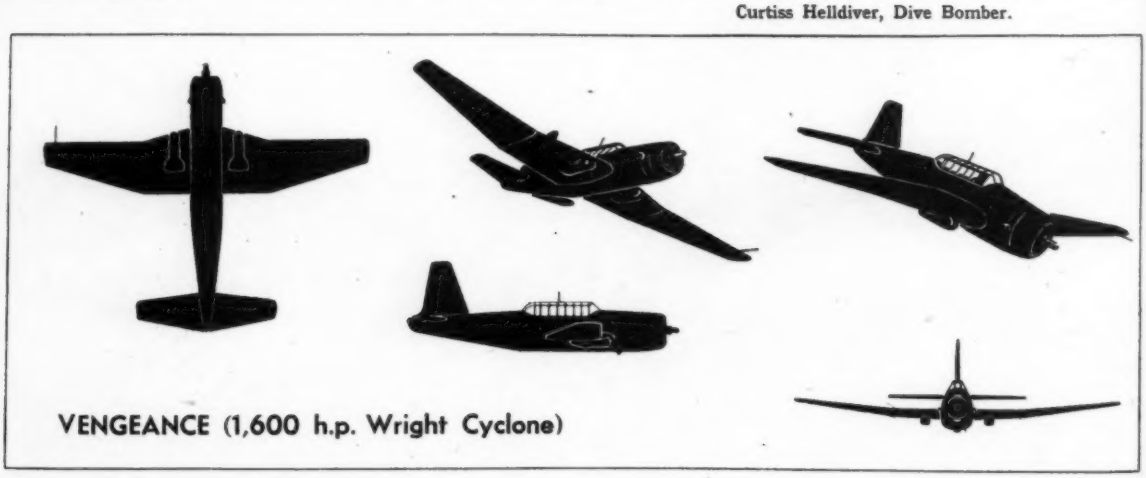
HELLDIVER (SB2C-1, 1,700 h.p. Wright Cyclone)

WHEN first introduced the Curtiss Helldiver did not fulfil expectations and production was suspended while some drastic "mods" were made, with the ultimate result that the U.S. Navy used its latest SB2C dive bombers with good effect in the recent invasion of the Marshall Islands.

The Helldiver is powered by a 1,700 h.p. 14-cyl. Wright two-row Cyclone and has a top speed of about 280 m.p.h. with internally stowed bomb-load Armament comprises two 0.5in. machine guns firing through blast tubes beneath the cowling and one "free" gun in the rear cockpit. Recognition points include low wings tapering on trailing edge only and round tips, "wing-nut" tailplane, large single fin and rudder, deep fuselage with long "glasshouse" and long blunt nose. Dimensions:—Span 49ft. 8in., length 35ft. 2in., height 16ft. 8in., wing area 422 sq. ft.



Curtiss Helldiver, Dive Bomber.



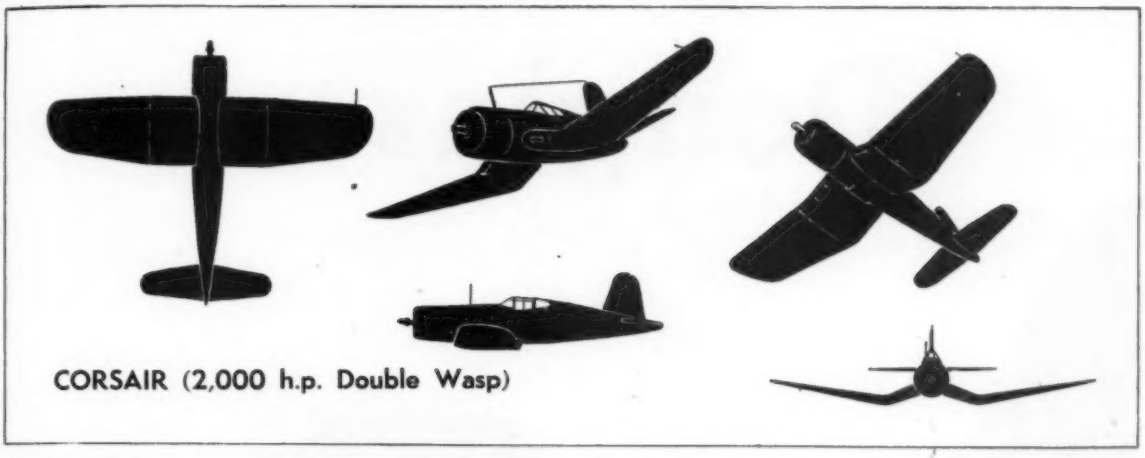
VENGEANCE (1,600 h.p. Wright Cyclone)

Vultee Vengeance, Dive Bomber.

THE Vultee Vengeance is now in service with the R.A.F. in India. Powered by a 1,600 h.p. 14-cyl. Wright Cyclone, its top speed is about the same as that of the Helldiver and it likewise carries its bomb-load internally. Armament includes a number of machine guns in the wings and a "free" gun in the rear cockpit.

Distinctive features include a wide flat centre-section with sharply backswept leading-edge and straight trailing edge, outer panels with straight leading edge and forward-swept trailing edge; this gives the square-tipped mid-wings the appearance of being cranked forwards. The fuselage is a fat oval with raised "glasshouse," the tapered tailplane has a wide span, fin and rudder are large and angular, and the undercarriage retracts backwards into fairings. Dimensions:—Span 48ft., length 38ft., height 12ft. 10in.

Fing Attitudes

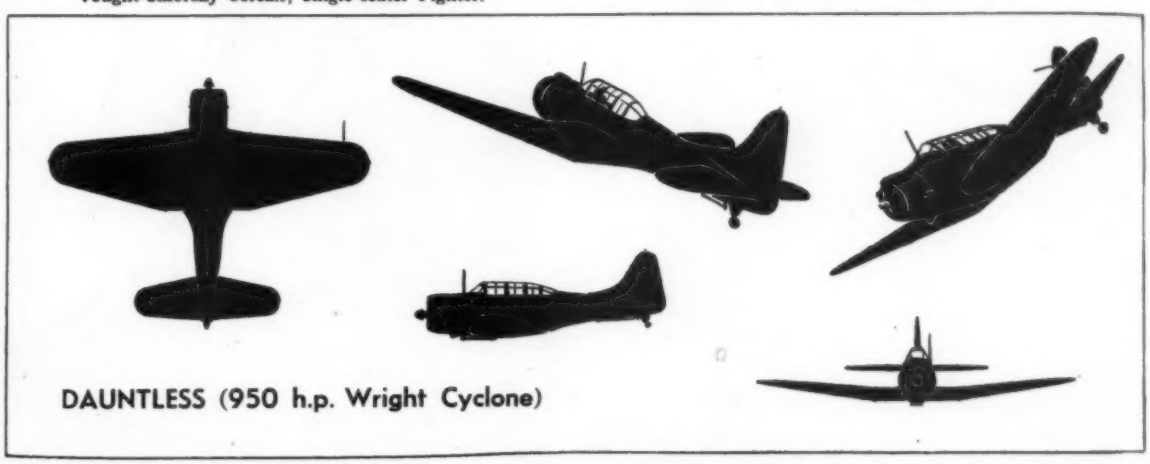


CORSAIR (2,000 h.p. Double Wasp)

Vought-Sikorsky Corsair, Single-seater Fighter.

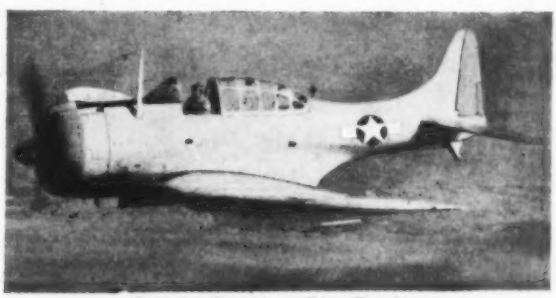
PRODUCED by Brewsters as the F3A-1, and Goodyears as the FG-1, as well as by its designers, Vought-Sikorsky, as the F4U-2, the Corsair is one of the U.S. Navy's latest and fastest single-seater fighters, now also used by the Fleet Air Arm. It is capable of over 400 m.p.h., and employs the 2,000 h.p. 18-cyl. Pratt and Whitney Double Wasp engine. Armament includes six 0.5in. machine guns in the wings.

The most distinctive recognition feature of the Corsair is its cranked low wings, in the leading edge of the downswept centre-section of which are seen the oil-coolers. In plan the wings taper only slightly from square centre-section to broad round tips and are of comparatively low aspect-ratio. The tapered tailplane, which also has round tips, is of much higher aspect-ratio. The large single fin and rudder has a broad rounded apex. Dimensions:—Span 40ft. 3in., length 31ft. 6in., height 11ft., wing area approximately 290 sq. ft.

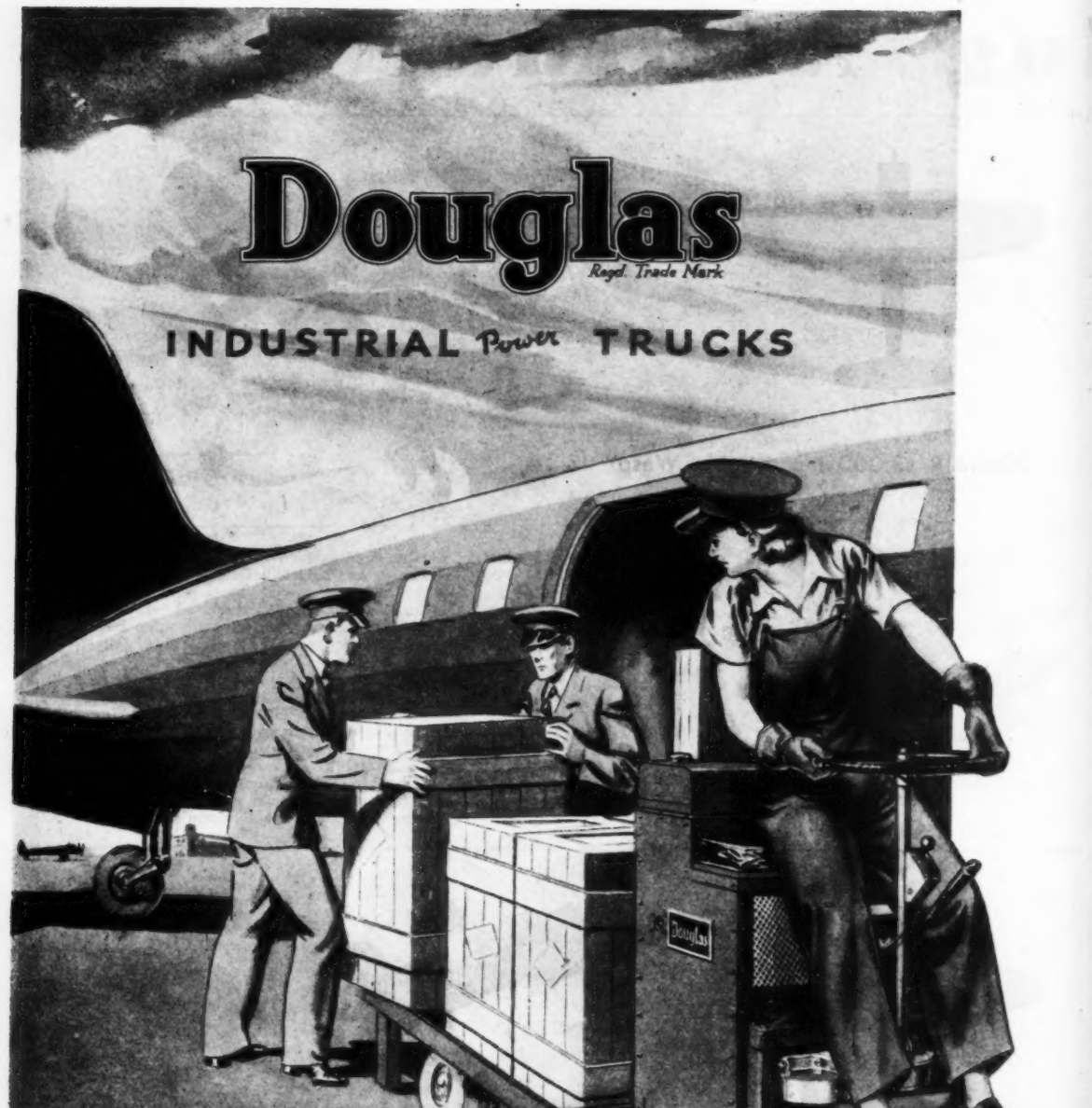


DAUNTLESS (950 h.p. Wright Cyclone)

A DEVELOPMENT of the U.S. Army's Northrop A-17A, the Douglas Dauntless is still in active service with the U.S.A.A.F. (A-24), and the U.S. Navy (SBD-3). Its 950 h.p. 9-cyl. Wright Cyclone engine gives it a top speed of 275 m.p.h. and it carries a 500 lb. bomb in a swinging cradle beneath the fuselage. External bomb-racks are also fitted, "letter-box" slots are incorporated in the leading edge of the wings, and split, perforated flaps, hinging above and below the trailing edge, act as dive-brakes. Low aspect-ratio wings taper to semi-circular tips and have large trailing-edge fillets on the flat centre-section. The tapered, round-tipped tailplane is unusually large and there is a dorsal fillet to the large tapered fin and rudder. The circular-sectioned fuselage tapers sharply aft of the rear cockpit. Dimensions:—Span 41ft. 6in., length 31ft. 9in., height 13ft., wing area 324 sq. ft.

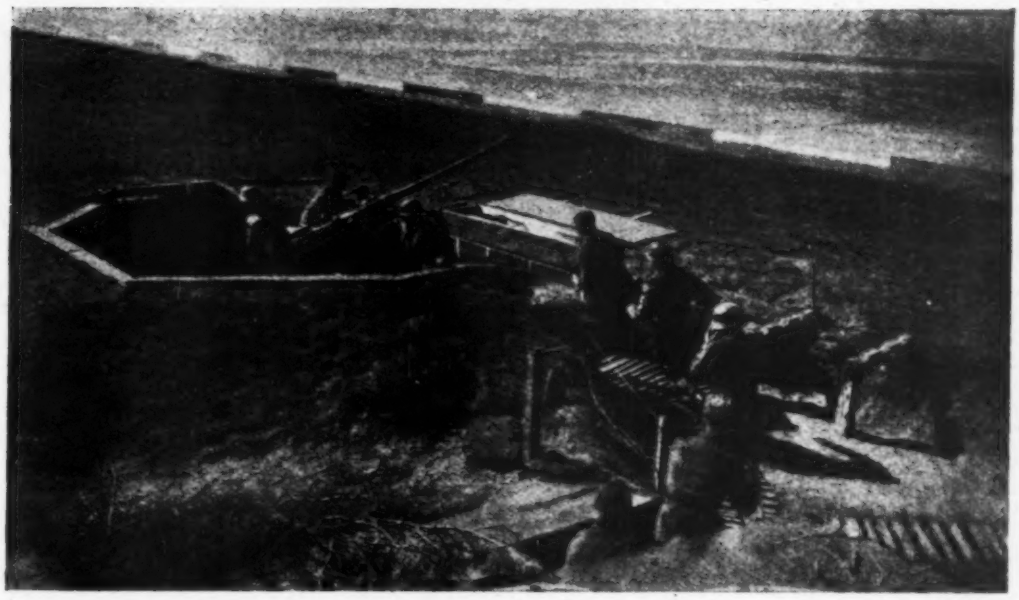


Douglas Dauntless, Dive Bomber.



DOUGLAS (KINGSWOOD) LTD., P.O. Box IF., KINGSWOOD, BRISTOL. (Tel. 73013.)
Export Division: Engineering & Aviation Exports Ltd., 50, Pall Mall, S.W.1. (Tel.: ABBey 6210. Cables: "Aerogal, London.")

Flak



OUTPOST DEFENCE: Light flak on an island in the North Sea. This is a typical example of a complete German A.A. gun emplacement widely employed for static defence. The gun is a 37 mm. Flak. Note the standard range-finder.

Continuous Development: Organisation and Formations: Tactical Conceptions: Equipment

By V. L. GRUBERG

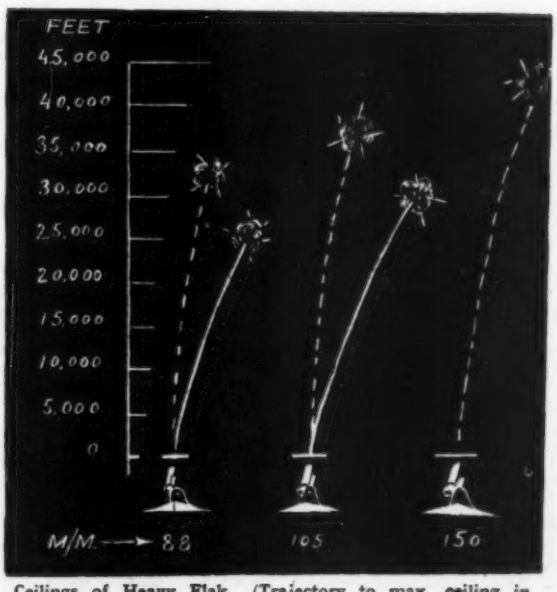
IN the years following Germany's capitulation relentless efforts were made to rebuild her anti-aircraft artillery.

The newly created streamlined *Reichswehr* had only one A.A. gun, the K.W.G.14. already then obsolete and capable of only 30 deg. elevation. The process of re-equipment and reorganisation, at first secret and after 1933 open, was concluded in 1935 when, on March 15th, the entire A.A. artillery was placed under the *Luftwaffe* for further expansion.

The subsequent despatch of A.A. units accompanying the "Condor" Legion to Spain proved a valuable source of experience. On the battlefields of Spain the Germans learnt the need for increased mobility of their A.A. guns, and all later developments have faithfully taken this lesson into account.

At the outbreak of this war a large number of motorised *Flak* units, together with their signal and staff organisations, were retransferred to the army so as to ensure a constant A.A. protection for the ground forces against low-flying attack by Allied aircraft.

At this juncture it is important to differentiate between the *Fla* and the *Flak* units. The former were in existence with the army for several years before the war. For its better protection the infantry had *Fla* companies and battalions equipped with A.A. machine guns. Today the *Fla* companies, equipped with 40 mm. M.G. "Vierlings" and single-barrel 20 mm. guns, are incorporated in the *Panzergrenadier* and armoured regiments; their task is the local protection of these units, of which they form an integral part and whose uniform they wear. The *Fla* weapon has also been employed against ground targets.



Ceilings of Heavy Flak. (Trajectory to max. ceiling in broken lines, to effective ceiling in full lines.)

A much later creation is the *Flak* (*Fliegerabwehr Kanone*). As already mentioned, at the outbreak of the war most of the *Flak* formations were still with the *Luftwaffe*. Only a relatively limited number of army *Flak* units were sent to Russia at the beginning of hostilities, appearing there for the first time on June 22nd, 1941. The development of this weapon,

FLAK

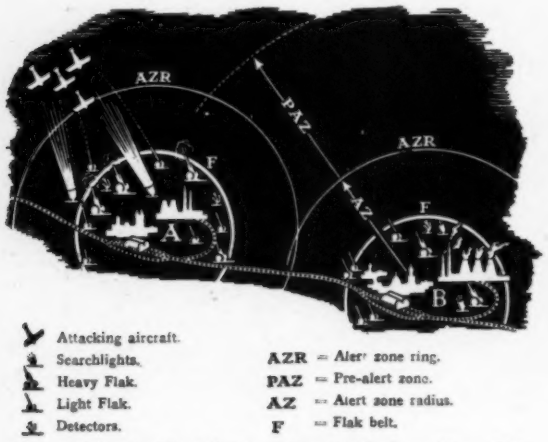


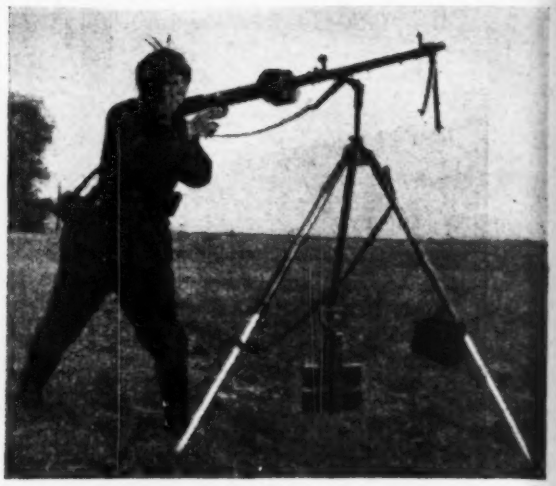
Fig. 1. **The flexible defence system of German cities. It is now more streamlined.**

speeded up with experience gained in France, was not then completed, and, according to German experts, the motorisation of *Flak* formations was still inadequate.

During 1942-3 the army *Flak* artillery was being further expanded and large numbers were employed on the Russian front, notably at Sevastopol, Stalingrad, etc.

The present organisation of the army *Flak* is based on heavy and light batteries. All units are independent formations attached to the armour and tank divisions. The commandant of a unit acts as adviser to the divisional commandant on all matters concerning the employment of *Flak*.

In addition to the primary task, which is the protection of ground forces against aircraft, Army *Flak* is extensively used against ground targets. The heavy batteries with their long trajectory, armour-piercing, high-velocity shells (800-900 yards per sec.) are particularly suited for anti-tank employment; light batteries are used for close defensive fighting, and in special cases to reinforce the fire of the infantry. As the most effective method of using heavy *Flak* against tanks, German experts recommend the opening of fire at the closest possible range—about 650 yards—at which the probability of hits increases and the evasive manœuvres of tanks are reduced.



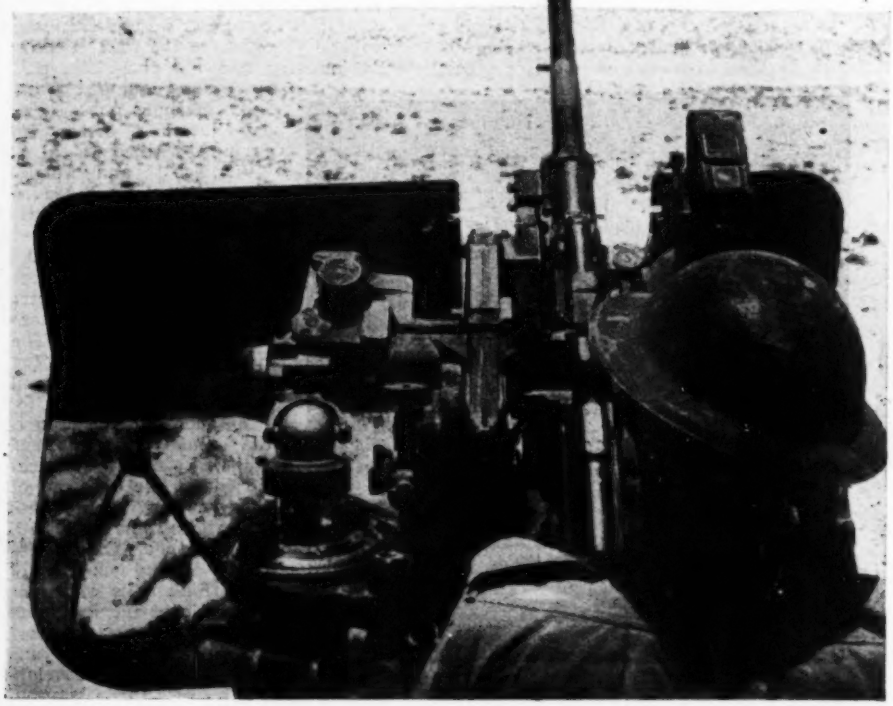
A *FLA* **WEAPON: The magazine-fed M.G.15 on tripod is used to protect infantry from low-flying attacks.**

Flak v. Ground Targets

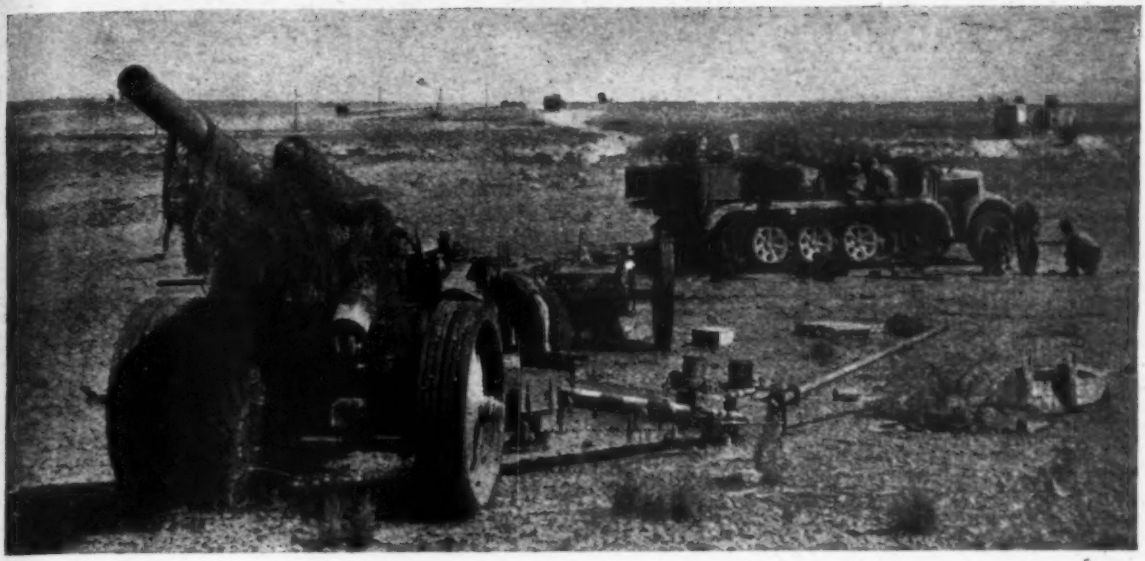
The employment of *Flak* artillery in the ground battle is usually carried out by "*Flakkampftruppe*" (*Flak* battle troops), composed of two heavy guns and several light ones, the latter taking over the protection against low-flying aircraft. A description of an action by such units on the Russian front contains this pregnant comment:—

"The enterprise of such "*Flakkampftruppe*" is usually a hard undertaking. While the artillery remains for long in their field positions, the *Flak* guns move up to within a short distance behind the first lines of the infantry, and at this close range open direct fire upon the enemy's resistance nests which the infantry cannot overcome. Frequently without cover, the *Flak-troop* itself is naturally very soon the target of the entire enemy artillery."

Despite this versatility, the employment of *Flak* guns against ground targets carries



CAPTURED: A rear view of the 20 mm. (0.79in.) Flak. The two main types in this calibre are the Flak 30 introduced in 1935 and the Flak 38, also used as an anti-tank gun.



HEAVIES: The range of German heavy types consists of calibres of 88, 105 and 150 mm. All of them are also employed against ground targets, but while the 88 mm. Flak 36 is drawn by track vehicles and its latest versions appear on self-propelled mountings, the 150 mm. gun is mainly used statically.

serious drawbacks. First, a prolonged experience of that kind reduces the efficiency of A.A. work; secondly, it is not always easy to replace casualties of highly trained experts, and, thirdly, because of the damage or faulty servicing of the highly sensitive equipment which is likely to occur in such actions.

Even German experts agree to the limitations of the ground employment of *Flak* guns. "In the employment of *Flak* in ground battles," says Lt. Gen. Weidinger, "it is to be borne in mind that it is the only weapon which can fight enemy aircraft at all heights, while ground targets can be fought with other weapons. The employment of army *Flak* artillery should, therefore, only take place when air superiority is established and/or other weapons are not available in adequate quantities."

Luftwaffe Flak

Army *Flak* against aircraft is employed for the usual protection of disembarkation and assembly points, traffic arteries, bridges and similar limited objectives, as well as for the protection of troops in the battlefield.

Since in combating aircraft by heavy *Flak* a certain density of fire is required, the Germans recommend firing in batteries, while in the case of light *Flak* firing is in small troops with a concentration—whenever possible—on one target.

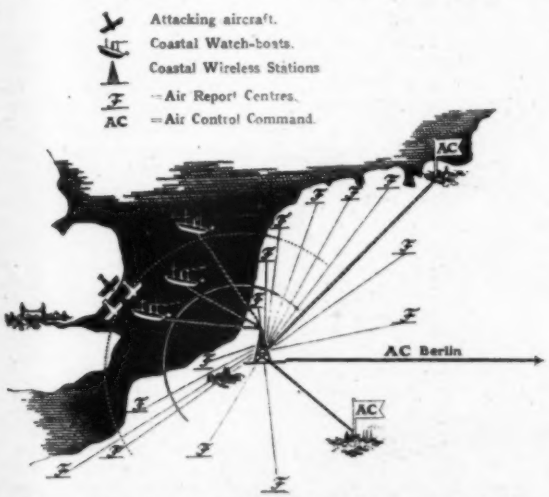
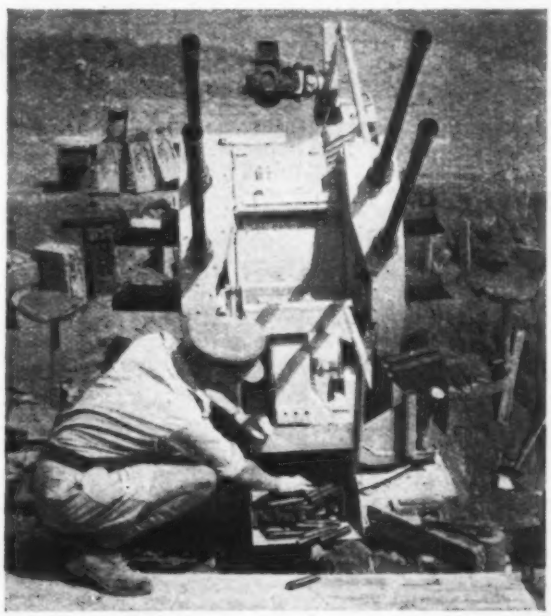


Fig. 2. Diagram of detection system of impending attacks.



IN CAPTIVITY: The Flak Vierling 38, a quadruple version of the Flak 38.

The *Luftwaffe Flak* artillery is organised in batteries, battalions and regiments. The latter are normally attached to a *Luftwaffe* corps, and consist of three or four mixed or light battalions.

The light battalion consists of two batteries equipped with 2 cm. guns and one battery of nine 3.7 cm. (1.48in.) guns, or, alternatively, of three light batteries each with twelve 2 cm. guns.

As its name indicates, the mixed battalion consists of a combination of heavy and light batteries, which is not

FLAK

always the same. In some cases it consists of up to three heavy batteries, each with four 88 mm. guns and some 2 cm. batteries; in other cases there are two light batteries, each with twelve 2 cm. guns.

While the mixed battalion has up to four light searchlight units, the light *Flak* battalion has about sixteen. In both cases the searchlights are of the 60 mm. type with a range of about 16,000ft. under conditions of good visibility.

Heimatflak

Searchlight units are motorised and include sound detectors, lighting plant, etc., and have their own signal formations. In some cases these are heavy searchlight battalions composed of four motorised batteries and equipped with 150 cm. searchlights. In good visibility their range is approximately 25,000ft. Attached to the heavy flak formations they are usually placed at the outer defences of the protected target. While the 60 cm. and 150 cm. searchlights are the most usual, some German units are equipped with searchlights of 100, 150, 200 and 230 cm. lens diameter.

If the views of Artillery General Becker, who, since 1911, has been connected with the technical development of German *Flak*, are to be considered as representative of German expert opinion, the role of searchlights is not highly valued. In his view the two main disadvantages of searchlights are that the light warns the aircraft, and prompts it to evasive manœuvres, and that their efficiency in cloud is nominal.

The anti-aircraft artillery inside Germany, the *Heimatflak*, consists of motorised heavy and medium batteries and stationary elements, the latter being in strong predominance.

While the equipment is, of course, of the standard German type discussed elsewhere in this article, the crews are largely composed of non-combatant men, part-timers and, more recently, with the increased demands on German man-power by *Luftwaffe* auxiliaries, boys between 14 and 17 years of age.

The methods of aircraft detection and warning, for which wireless is extensively used, has undergone various changes, and little public information is available on this subject. The following description is, however, extracted from enemy sources: "The warning of approaching aircraft is transmitted by wireless from advance watch-boats to coastal stations and is immediately passed on direct telephone lines to all inland report centres as well as to the nearest air watch command, and to the air watch command at Berlin. As soon as enemy aircraft cross over the outer limits of the pre-alert zone of the coastal stations (broken line in Fig. 2) an alarm is given.

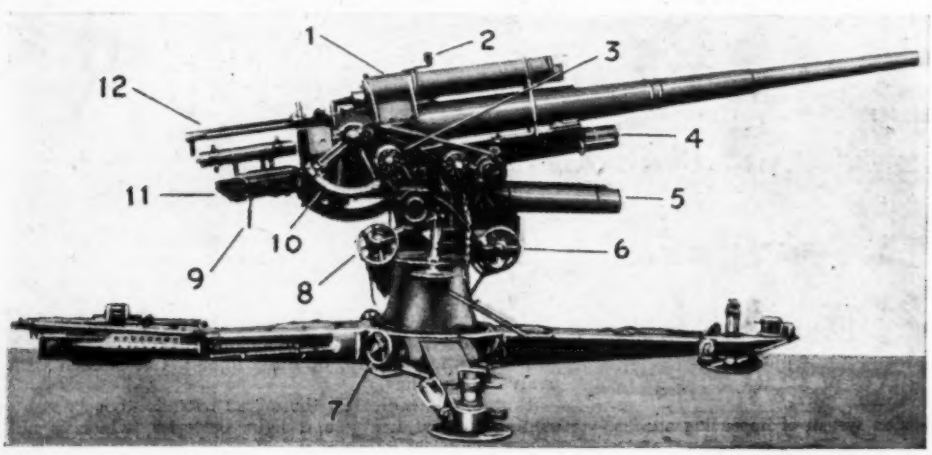
"At this stage searchlights, sound detectors and predictors are manned, and guns kept ready to fire awaiting orders transmitted electrically.

Defence System

"As soon as the attacking aircraft cross the alert zone (AZR in Fig. 1) of town A, all railway and industrial establishments are completely blacked out. Searchlights begin to play and some batteries open fire. In the neighbouring town B there is only the usual partial black-out because the aircraft have not yet crossed the pre-alert zone (PAZ) of B. *Flak* units are not manned except for guards."

There is little doubt that with the intensification of Allied air attacks this method, which is based on reports published early in 1943, has been changed and the whole warning system substantially accelerated.

The 37 mm. (1.45in.) Flak 36, a development of the Flak 30 has an effective ceiling of 11,800ft. Figures in German flak designations indicate the year in which the type was put in service.



Close-up of the 88 mm. gun: (1) Recuperator. (2) Dial Light. (3) Elevation Receiver. (4) Hydraulic Buffer. (5) Balancing Springs. (6) Traversing hand wheel. (7) Cross levelling hand wheels. (8) Elevation hand wheel. (9) Firing lever. (10) Scale. (11) Position of loading tray. (12) Rammer.

FLAK

The principal weapons of the German *Flak* are medium and light guns of 20, 37, 40 and 50 mm. calibre and heavy types of 88, 105 and 150 mm. In addition, the standard German machine guns mounted on tripods are employed against low-flying aircraft. Of the light types the most predominant are the 20 mm. (0.79in.) *Flak* 30 and the *Flak* 38 of the same calibre.

The *Flak* 30 2 cm. (0.79in.) gun was first introduced into the German Navy in 1930, and about five years later into the *Luftwaffe*. The usual practice is to mount it on a single-axle motor-driven trailer, but the gun can be man- or horse-drawn or mounted on rail vehicles.

The *Flak* 30 features a detachable barrel 51.2in. long, and a single-shot and automatic mechanism. It is recoil-operated and fed by a flat box magazine with a trigger system actuated by a pedal.

Light and Heavy Types

In 1940 a new version was introduced, the 2 cm. (0.79in.) *Flak* 38. As may be seen from the table of comparative performances of the two guns, there is little to choose between them, the main difference being in the substantially increased cyclic rate of fire of the newer gun.

The *Flak* 38 is of the recoil-operated type, the mechanism being operated by a short barrel recoil and the residual gas pressure in the barrel. The latter, equipped with a flash eliminator, has a length of 56.6in. After unlocking the breech, the recoil imparts acceleration to the breech-block carrier.

The residual gas pressure in the barrel after the completion of unlocking assists this rearward acceleration so that the breech block travels back with sufficient force to perform the operations of extraction, ejection and compression of the return spring. The gun is fed from a flat curved box magazine containing 20 rounds.

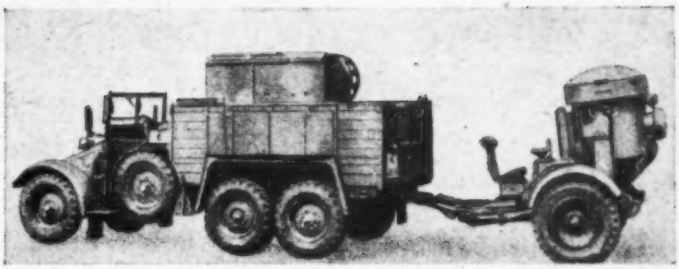
Four *Flak* 38s mounted together bear the designation of *Flak "Vierling"* 38. Employed for both ground and aerial targets, the *Vierling* is mounted statically or on rail or track vehicles and trailers. The trigger mechanism is actuated by two pedals, one for the left and one for the right foot, each operating two diametrically opposite guns. The four guns can be fired together or in twos until the pedal is released or the magazine emptied.

Muzzle velocity and vertical range are identical with the *Flak* 38; the theoretical rate of fire is between 1,680 and 1,980 r.p.m., and the practical 720 to 880 r.p.m. Elevation is −10 deg. to +100 deg. and traverse 360 deg.

The 37 mm. *Flak* 36 is also a dual-purpose gun weighing 1¼ tons in action, with a muzzle velocity of 2,700 ft./sec. and a vertical maximum range of 15,750ft. Effective ceiling is 13,750ft. Its theoretical rate of fire is 140 r.p.m. and practical 60 r.p.m.

From the equipment and industries of subjugated countries the German *flak* arsenal has acquired several A.A. types. Among them is the 40 mm. L/60 *Skoda Flak*, identical with the well-known Bofors, and the 20 mm. M.35 of the Zbrojovka in Brno. Among more recent acquisitions of light and medium equipment, it is reasonable to assume that some of the Italian *flak* is being used.

	Weight in use	Weight in draught	Muzzle Velocity (HE)	Horizontal Range (max)	Vertical Range (max)	Cyclic Rate of Fire	Practical Rate of Fire	Elevation
	cwt.	cwt.	ft./sec.	yds.	ft.	r.p.m.	r.p.m.	deg.
Flak 30	9¼	15	2,950	5,230	12,100	280	120	−12 to +90
Flak 38	8	14¼	2,950	5,230	12,400	420–480	180–220	−20 to +90



The 60 cm. mobile searchlight is the most widely used type and is standard with light Flak units.

PANZER MOUNTED: The Vierling Flak mounted on an armoured train. Such trains, used by the Germans on the Russian front, had the dual task of protecting vital railway lines from guerillas and aircraft attacks.

In the heavy category the standard German type is still the 88 mm. (3.46in.) *Flak* 36, earlier models of which were used by the Condor Legion in Spain. Since then the gun has gone through a series of modifications, particular attention being paid to increase its mobility. The most recent version is self propelled, but this type can only be used for ground targets.

The gun, which slides on guideways fixed to the breech, is loaded by an automatic rammer and a loading tray. The self-cocking breech—which in necessity can be operated by hand—slides horizontally and opens, ejecting the case as the gun is run out, simultaneously effecting the compression of the striker and of the springs operating the breech block. During the opening movement of the breech the striker is cocked; the withdrawing of the loading tray operates the firing mechanism.

The muzzle velocity of the *Flak* 36 88 mm. is 2,690 ft./sec. and the practical rate of fire 15 to 20 r.p.m. Maximum vertical range is 32,500ft. The gun is capable of a maximum elevation of +85 deg., and a maximum depression of −3 deg. Length of barrel is 194in. and of bore 161in.

While this gun is the most frequently encountered German "heavy," two other types are also in service: the 105 mm. dual-purpose gun which now seems to be in extensive production, and the 150 mm. *Flak*, mainly used statically. A comparison of the approximate ceilings of the three German "heavies" is shown diagrammatically on the first page of this article.

To complete the stocktaking of the German *flak* formations one may add an Italian type which has been in service: the 90 mm. multi-purpose tractor-drawn gun with a muzzle velocity of 2,750 ft./sec., 15 to 20 r.p.m. practical rate of fire, and a listed maximum ceiling of 39,400ft.

With the intensification of the air war against Germany, the consequent need for improved protection of their cities presses the Germans to place their production of *flak* guns on a high priority.

Friendship Established

When the Guild of Air Pilots and Navigators, British Air Line Pilots and Guests Dine Together

AS briefly recorded in last week's issue, members of the Guild of Air Pilots and Navigators and of the British Air Line Pilots' Association entertained guests and one another at a dinner held at the premises of the Royal Aeronautical Society on February 4th. Capt. A. G. Lamplugh, who is chairman of the Guild's War Emergency Committee, welcomed the diners. He recalled that the G.A.P.A.N. was now 16 years old, and that during the war its activities had been curtailed, not least by the fact that its premises had been blitzed in 1940 and had had to "go into cold storage." The joining of forces with the British Air Line Pilots' Association (recorded in *Flight* of November 18th, 1943), marked a turning point, and it had been decided to form a new Court. The task of both bodies was to hand over to younger and more virile people, and to look after the interests of the younger generation.

Mr. W. P. Hildred, Director of Civil Aviation, said he welcomed the coming together of the G.A.P.A.N. and B.A.L.P.A. There was much work to be done, and standards which had of necessity been lowered during the war would have to be restored. He thought those assembled might like to know something of what the Directorate of Civil Aviation was trying to do, and what had been accomplished. They all know of the huge Brabazon I post-war aircraft. In addition there were others projected. After the war radio was going to play a very important part. The Department had made enquiries and had been told enough by the Air Ministry to enable it to form some idea of what one might hope to achieve after the war in the application of radio to commercial aviation. It was important that in the post-war years there should be uniformity of radio equipment in the world, and he had hopes that a considerable measure of uniformity might be achieved.

Importance of Payload

Mr. Hildred spoke with feeling of the importance of the economics of flying after the war. (He was "reared," so to speak, as a Civil Servant in the Treasury.—ED.). The payload problem was equal in importance with the radio question, and it was scarcely an exaggeration to say that we ought to build our aircraft around the radio equipment.

The question of airports was sheer dynamite, so far as international agreement was concerned. There was going to be keen competition, and as a guide his department had recently issued a little booklet in which were set out the dimensions and technical characteristics needed in post-war airports for different types of airline traffic.

Mr. Hildred disclosed the interesting fact that his department had succeeded in forming a development flight for which it was hoped to obtain several new types of aircraft in order to test them operationally before they actually went into service on air routes. This appears to be an admirable principle which deserves all the support which manufacturers and operators can give it.

In the political field there was much to keep the Department of Civil Aviation awake at nights. No fewer than three heads had to be satisfied: Lord Beaverbrook, Sir Archibald Sinclair, and Capt. Harold Balfour. They were the people who would decide major policy. He (Mr. Hildred) could not reply to questions concerning the organisation of international aviation, one or more "chosen instruments," and so forth.

Glorious Uncertainty

After the war the regulations governing civil flying would need to be redrafted, and at present they had a committee sitting for the purpose of making a study of the subject.

Mr. Hildred concluded by pointing out that although his department was working hard and was making plans and recommendations, there was a glorious uncertainty about everything. "All," he said, "can be swept away in a five-minute talk between Washington and London."

Mr. Laurence Wingfield, Clerk of the Guild, said he was a very happy man that evening. When they started planning the dinner they thought they would be doing well if they got together some 25 people. Actually they had brought together no fewer than 75 members and guests. He stressed the great influence which the two bodies could have on post-war flying, and pointed out that there was one interest which pilots and the public had in common: safety. The public did not quite know what was meant by the expression, but the pilots did.

Short speeches were also made by Major Samarin, Soviet Military Air Attaché, by Cmdr. Edward A. Bret (Free French), and by Capt. Nieumenhuis, of the K.L.M. The last named recalled that the origin of the K.L.M. was the ELTA show in Amsterdam in 1919. Mr. A. Plesman, who was president of the exhibition, became head of the K.L.M., and when they started they sought and got the co-operation of Great Britain, borrowing several British pilots, notably Capt. Olley.

Capt. Nieumenhuis, who had recently returned from America, said he had there met an old friend of theirs, Capt. Smirnov, who had had a couple of Japanese bullets extracted from his anatomy. He still spoke neither English nor Dutch (Capt. Smirnov is a Russian, who worked for many years as a pilot for the K.L.M.), but was writing a book about his experiences.

SHOCK WAVES AT SONIC SPEEDS

Lecture to Luton Branch of R.Ae.S.

THE limitations of aircraft speed and the possibility that jet-propelled aircraft will be able to overcome some of the difficulties he described were the subject of a lecture given on Wednesday, February 9th, to the Luton Branch of the Royal Aeronautical Society by Dr. W. F. Hilton, B.Sc., A.R.C.S., D.I.C., of the Aerodynamics Department at the National Physical Laboratory.

Dr. Hilton illustrated his lecture by excellent lantern slides showing photographs obtained in various wind tunnels of the shock wave which forms on top of an aircraft wing as the machine approaches the speed of sound. The term "shock stall" often used in this connection means the formation of a shock wave above the wing and is not to be confused with the ordinary term "stall," meaning loss of flying speed under normal conditions.

The speed of sound is about 770 m.p.h. at sea level and less in proportion to height and the temperature of the air. The present limit of speed of an aircraft wing shaped like that of the Spitfire, Dr. Hilton put at about 600 m.p.h. A thin wing may help to avoid the shock stall caused by increased drag as the speed of sound is reached, and the angle of incidence (i.e., the angle at which the wing meets the oncoming air) may also affect its formation. But a wing which by its shape will give greater efficiency at high speeds in the air may also be one which is dangerous to land because of high wing-loading.

A shock wave is sometimes formed at the tip of an airscrew blade since the airscrew blade tip travels much faster than the aircraft itself by virtue of its rotary and forward motion; the speeds of aircraft equipped with airscrew are limited by the formation of this shock wave. A jet-propelled aircraft, on the other hand, is capable of much greater speeds than the ordinary type, because it has no airscrew. Of course, it still has to contend with the formation of shock waves on the wings. Jet-propelled aircraft are at present inefficient at low speeds and consume a disproportionate amount of fuel, but the higher the speed the more efficient such an aircraft becomes.

These shock waves can be photographed because air has the power of refracting light when it is warm and agitated, as anyone may understand from seeing the wavy outline given by hot air over a radiator to objects behind it, or by heat haze on a summer day. Dr. Hilton's last slide showed a little white figure with imp-like outline. This, he explained, was what he developed one day when he detected a light in his camera that should not have been there—a wind tunnel Gremlin!

Mr. A. A. Bage, A.F.R.Ae.S., chief designer of Percival Aircraft, Ltd., took the chair.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers not necessarily for publication, must in all cases accompany letters.

JET PROPULSION

Opinions Wanted

MY friend and I were discussing the possibilities of jet propulsion and this point cropped up: Would it be possible for a 35,000-ton battleship to be driven by jet propulsion with no under-water drive?

My theory is that such a displacement would need an under-water drive and I should be very pleased to hear opinions on this subject. A. L. WARD.

Reaction in a Vacuum

YOUR correspondent "Sywell" appears to have forgotten that the exhaust gases from a jet-propelled aircraft have a definite mass and that it is the kinetic energy imparted to this mass that provides the reaction which, according to Newton's Law, equals the action on the aircraft.

This action will obviously result even in a vacuum.

"Projet" has overstepped his theory in this respect when he declares "there is no need for propulsion in a vacuum once the required velocity has been attained." In this case, of course, gravity will take charge and the aircraft will no longer continue in level flight.

As I see it, the solution to Mr. Morrell's problem lies in the fact that the air passing through the radiator of the Spitfire expands on being heated, thus giving an increased velocity of flow, assuming equal area of entrance and exit. As the mass flow remains constant throughout, the radiator exhaust will have greater kinetic energy than the air entering (per unit mass). "A. J. A. R."

Pressure Exerted in All Directions

HAVING read "Sywell's" letter in the last issue of *Flight*, dated January 27th, concerning an interesting controversy as to whether a jet-propelled aircraft is entirely dependent on an atmosphere or not, it is my opinion that the validity of his opponent's argument lies in the fact that gases exert equal pressure in all directions, whether or not they are moving relative to an aircraft or any other body.

If this is kept clearly in mind it will be seen that when compressed gases are expelled from a plane in a direction opposite to that in which the plane is travelling, they will exert pressure in all directions much greater than that of the atmosphere because they are compressed and suddenly expand, and a fraction of the total pressure created by the expelled gases reacts on the plane in one direction only and thus propels it along. The principle of jet-propulsion is therefore independent of any surrounding medium and this explains the ability of a "jet-craft" to fly at great heights with little reduction in speed, if any at all.

Exactly the same principle applies to a rocket, which, as "Sywell's" opponent argues, will work in a vacuum, and the reason for this is precisely as stated above—gases exerting pressure in all directions, and propelling the body forward when ejected in a stream from behind. This is why rockets would be the best means of interplanetary travel where they would need to operate in partial and almost perfect vacuums.

This explanation, I hope, will clear some of the doubts in your correspondent's mind. R. L. GLADWELL.

Intake Suction the Major Force

MAY I be permitted to reply to Mr. Sywell's letter in this week's issue?

It appears to me that the J.P. aircraft is a combination of tractor and pusher, but chiefly tractor. This tractor force is brought about by the air which is drawn into the duct in the nose (by a blower when stationary), being expanded many times by heat, in a special chamber, and blown out with almost explosive force. By means of special ducting surrounding the J.P. motor, expansion chamber and jet, a very powerful suction is created at the duct in the nose. The jet impinging on the wall of air at the tail is a secondary and less important force. An ordinary radiator of the ducted type is similar and makes use of engine heat to expand the air passing out of the duct and creating suction at the entry, I believe.

When the J.P. aircraft is flying in rarefied air I imagine additional heat is necessary in the air expansion chamber to maintain the same pressure obtained lower down. There is some compensation in the lower skin friction at high altitude.

From the above it will be seen that J.P. will not operate in a vacuum and therefore there will be no trips to the moon by this means. The rocket, in my opinion, will also not operate in the vacuum, as it does not conform to Newton's law, and requires a wall of air, or resistance in some form. However, it would travel some distance outside our atmosphere, which would depend on weight of projectile and amount of propellant used. On these factors depend the amount of kinetic energy imparted to the rocket in the atmosphere. It is therefore surely kinetic energy only which would propel a rocket through a vacuum.

But are we correct in assuming that there is a vacuum outside the earth's atmosphere?

There are only three forces which move constantly, or cause movement in a vacuum, (a) electronic force, (b) magnetic force, (c) gravitation. N. V. BRITTAIN.

Definition of a Force

ALTHOUGH "Sywell" is wrong in his contentions it may be of some comfort to him to know that many people with whom I have talked have (or had, I hope) the same ideas as he has. I fear his chief trouble is that he does not know what a force is.

The definition of a force is that which, when applied to an object accelerates, or tends to accelerate, it in the direction of that force. Perhaps a better definition is that which when applied to an object accelerates it in the direction of that force in the absence of an equal and opposite force. From this it follows that to accelerate an object a force must be applied in the direction of the acceleration.

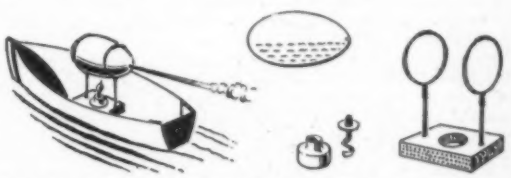
In jet propulsion air is taken in at the front and sent out of the back at a much higher speed. A mass of air has thus been accelerated in a backward direction. Thus a force must have been applied to it in a backward direction. It is the reaction to this force which is equal and opposite which drives the aircraft forward.

B. P. SKINNER.

WHEN EGGS WERE EGGS

Jet Propulsion 50 Years Ago

SOME 50 years ago or so, I remember, there was published in one of the American journals of popular science—probably *Scientific American*—a description of an interesting experiment with jet propulsion. The reader was instructed to take an egg (he could in those days!), prick a tiny hole with a needle in the pointed end of the egg, and then suck out the contents. This was a slow and somewhat messy business. He was then told to make a paper boat, some five inches long, and varnish it to make it watertight.



On the floor of the boat were placed two wire supports for the egg, the wooden base for the supports having in the centre a hole for an ink well. A wick was inserted and the ink well filled with petrol or paraffin. Water was then persuaded into the egg, up to the level of the hole. The flame from the ink-well burner would in time turn the water in the egg into steam, and the boat travelled along, quite fast as a matter of fact. J. P.

BROADCAST ELECTRIC POWER

Not a Practical Proposition

AS a reader of *Flight* for many years, I would like to answer "Typhoon," whose letter headed "Possibility of Broadcast Electric Power" gives an entirely erroneous impression of the possibilities of radio. It should be understood that there is a vast difference between *controlling* an aircraft by radio and supplying sufficient motive power to *propel* an aircraft by radio. The "signal" transmitted by the most powerful transmitting station on earth (which I believe is near Moscow) has not sufficient power to move even the most sensitive instrument

CORRESPONDENCE

until amplified by some electronic apparatus which must exist at the site where it is intended to receive the "signal." Now, a fair or average amplifier will give an output of, say, about 20 watts for a weight of roughly 20 lb.; also 746 watts = 1 h.p. Thus we should need an output of 1,641,200 watts to equal the power developed by the "Sabre" engine, *i.e.*, 1,641.2 kilowatts.

I believe I am correct in stating that the total radio power transmitting stations in this country generate 5,000 kilowatts, and so, according to my admittedly Heath Robinson analysis, we should need an aircraft with a wing area about the size of Surrey, and even then our radio set would not generate enough power to move it.

I would like to add that I obtained most of this information from your sister journal, *Wireless World*, to which I am also a regular subscriber

F. WRIGHT.

Present Known Principles Not Applicable

HESITANT as one is to-day to use the word "impossible" when discussing future invention, I think one may say that none of the present known physical principles are applicable to the problem of effective power transmission by radio.

Even foreseeing, with "Typhoon," a beam system so perfected that all the transmitted power is put to full account by the consumer aircraft, full efficiency could only obtain if the supply were just equal to demand.

This equality must assume either a constant consumer load or the pilot's control of station output. Neither condition is easy to imagine, particularly when several aircraft are routed on a common beam.

Normal electrical traction is effective and efficient partly because of the negligible transmission losses and partly because the supply to the rails is never more than the demand. It may be said that here the fuel consumption of the power station is virtually linked to the control levers in the drivers' hands.

I recall, with "Typhoon," the newspaper account of the hypothetical "magnetic currents" adduced by an American experimenter. Details were lacking, but it would appear that the electrolysis encountered at the poles of a magnet, immersed in acidulated water, might well be ascribable to an electric current resulting from normal electro-magentic *induction*.

The need of an intense magnetic flux is quoted, and it may well be that a sufficient movement of the electrolyte, due to bubble formation and other causes, would occur and would produce a "cutting of lines of force" with a generation of current.

The necessary closed circuit would be provided by the iron core of the magnetic system and the electrolyte itself. It would be interesting to know the result of interrupting this circuit by an air-gap small enough to retain the high flux density.

In my own view (and "Typhoon" does invite opinion) the present practice of carrying the "fuel" on the aircraft will continue for a long time yet with further progress in the design of the prime mover and the means for converting its power to useful thrust.

The recently publicised success of jet propulsion marks an historical and logical step in this direction both by the elimination of reciprocating parts of the normal I.C. engine and by the elimination of an airscrew. It has also led to a widening of the range of useful fuels.

Aircraft have never really been other than *jet-propelled*, and we witness now a potential substitute for the airscrew which was fast approaching the limits of its usefulness.

FRANK A. GOODLIFFE.
(Director, Science Films, Ltd.)

From Lord Ventry.

When the Airship Scores

IF I may, I would like to add a little to Major Robertson's most interesting article in *Flight* of February 3rd.

The pilots of the raiding airships of the last war liked clouds to escape into, and many a Zeppelin unfortunately escaped from our aircraft in this manner. Again, in October, 1918, the Italian Army airships were going aloft under such visibility that H/A were grounded, and yet managed to make useful raids on German communications.

The same is true of to-day, for the U.S. Naval airships are often able to go out on anti-submarine operations when, owing to bad weather conditions, the H/A machines are not able to go out. Perhaps I might also be allowed to blow our own L/A trumpet just once!

H.M.A. *Delta*, piloted by the late Major E. M. Maitland—as he was then—and afterwards by Captain C. M. Waterlow, later killed as a Wing. Cmdre., R.N.A.S., went aloft in the Army manœuvres of 1913 when the clouds were about 500 feet, and mist stopped the H/A from operating. Mr. Churchill was taken for a flight in No. 3 command by the late Wing. Cmdre. N. F. Osborn, R.N., when the fog was so thick at Farnborough that it was hardly possible to see the length of the ship, and yet she arrived on time.

VENTRY.

CIVIL AVIATION

Room for the Competitive Spirit

WITHIN American aeronautical circles it is confidently assumed that post-war civil aviation will continue to run on a private enterprise basis, and, in comparison with our own hazy conception of a Government-controlled organisation, their outlook is a happy one.

It is my candid opinion that competition is essential for the continued progress of civil aviation. One has only to look at the slow rate of development of combines like the British railways, which has been eclipsed time and time again by the revolutionary strides of the airline companies, to appreciate that accumulative control can, and usually does, have a marked bearing of a detrimental character upon large concerns. There is not the same fighting spirit for business supremacy and expansion, since they have the tendency to be independent.

It does not necessarily imply that certain Government services may not be required in order to benefit sections of the British Empire, or for various reasons of State, due to receipts not being able to balance expenditure. But, on the whole, the post-war civil aviation reconstruction programme should be drawn up without delay by a special committee representing parties interested in airline operations, and an earnest endeavour made to establish some worth-while details on which to base future developments.

ERIC LORRAINE ADLEM.

THEORY OF FLIGHT

Up and Down Wind

I REFER again to the subject of optimum gliding speeds, in case no one else has by the time this reaches you given the simple explanation which seems to be required.

If an aircraft is gliding upwind its resultant path over the ground is the difference between the distance flown through the air and the distance the air as a whole was moving over the ground during the time of the aircraft's flight. The latter distance depends, for a given wind velocity, solely on the time of flight. In gliding downwind the resultant path over the ground is the sum of the two distances. It is therefore clear that anything which tends to reduce the time of flight without affecting gliding angle (and therefore distance flown through the air) is beneficial in a glide upwind, and anything which tends to increase the time of flight is beneficial in a downwind glide. Therefore, as a correspondent has already stated, hang on to everything you have got in gliding upwind and lighten ship when gliding downwind.

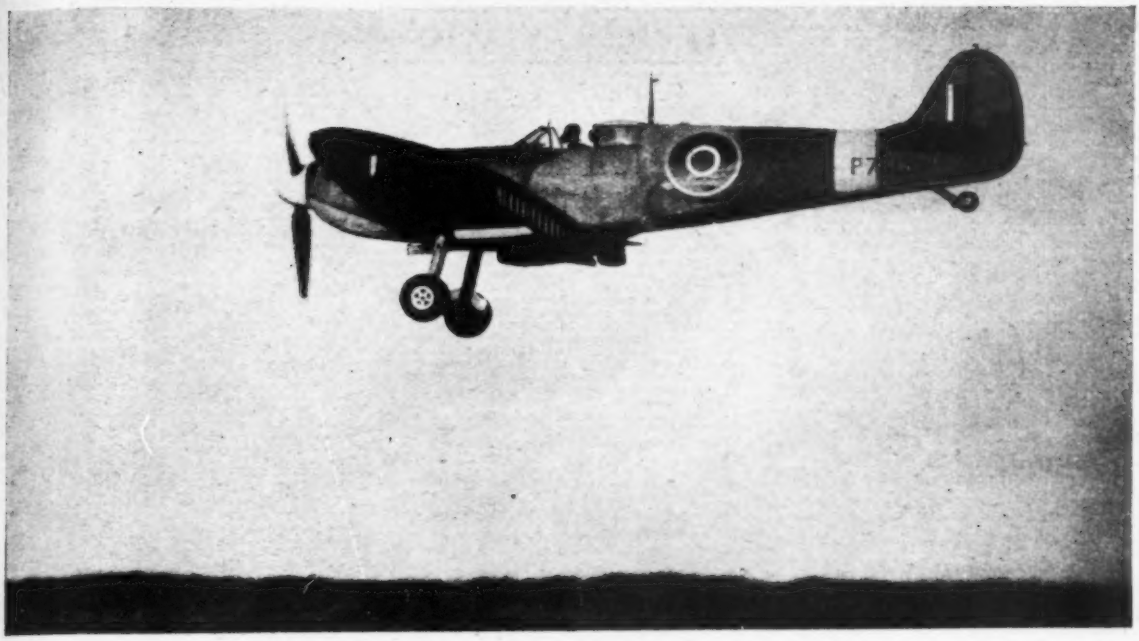
Secondly, there is the question of departing from the speed which gives the best gliding angle with the particular load on board. If an aircraft gliding upwind increases its speed above the optimum it may, for example, get down ten minutes earlier but lose five miles on the glide. But if the wind velocity was 30 m.p.h. it will have saved five miles of wind drift, and in a higher wind it would have saved more than it lost. There must therefore be a certain wind velocity which justifies a given increase in speed, and it follows that there must be a certain optimum speed for any given wind velocity. The same argument can be applied conversely to downwind flight; useful decrease of speed being limited naturally by the rapid change of characteristics around the stall.

There is in fact only one condition of wind in which optimum speed for ground distance covered coincides with optimum speed for gliding angle, namely, a calm (and possibly also in true cross-wind flight, but this is rather complicated).

It would be most interesting if an expert with the necessary information would produce a graph for any particular aircraft showing optimum gliding speeds for ground covered, plotted against wind velocity (head and tail winds), with speeds for best gliding angle and minimum rate of sink also shown. It would also be interesting to know the mathematical result of jettisoning 100 lb of equipment from any particular type of aircraft gliding at the resulting optimum speed with and against a wind of, say, 30 m.p.h

The figures are likely to be small for high-speed aircraft, but there may be all the difference in the world in a couple of feet for an aircraft in distress.

R. E. PEARS,
Capt., R. Signals.



LEARNING TO TEACH: A Spitfire of the Empire Central Flying School comes in to land. Pilots of all nations come to the E.C.F.S. to learn the art of teaching flying.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News and Announcements

Appointments

AIR COMDRE. J. A. STONE, C.B., air officer commanding a group in Maintenance Command, has been appointed to the rank of Acting Air Vice-Marshal, retaining his present command.

Air Comdre. E. J CUCKNEY, C.B.E., D.S.C., has been appointed air officer commanding a group in Maintenance Command with the rank of Acting Air Vice-Marshal. He was previously principal deputy director of servicing and maintenance in the department of the air member for supply and reorganisation at the Air Ministry.

Promotion

GENERAL DUTIES BRANCH.

AIR COMDRE. (temp.) G. G. BANTING, C.B.E., is granted the rank of Group Capt. (war subs.), January 1st, 1944.

Retirement

GENERAL DUTIES BRANCH.

GROUP CAPT. (temp. Air Comdre.) H. G. BOWEN, M.B.E., is placed on the retired list and retains the rank of Air Comdre. February 1st, 1944

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

Bar to Distinguished Service Order

Act. Wing Cdr. L. V. CHADBURN, D.S.O., D.F.C., R.C.A.F.—This officer has displayed outstanding leadership, great tactical skill and courage. Since being awarded the D.S.O. he has led his formations in a large number of sorties during which 23 enemy aircraft have been destroyed and many others damaged; Wing Cdr. Chadburn shot down six of this total himself.

Sqn. Ldr. H. B. VERITY, D.S.O., D.F.C., R.A.F.V.R., No. 161 Sqn.—Since being awarded the D.S.O., Sqn. Ldr. Verity has completed very many sorties, all of which have demanded a high degree of skill and determination. He is a most inspiring leader and his achievements have been outstanding

Distinguished Service Order

Act. Wing Cdr. R. A. CHISHOLM, D.F.C., A.A.F.—This officer has completed an extremely large number of sorties at night, during which he has destroyed nine enemy aircraft. He has displayed exceptional skill and keenness and, both in the air and on the ground, his outstanding qualities and personal example have contributed materially to the efficiency of the unit he commands.

Act. Wing Cdr. P. B. LUCAS, D.F.C., R.A.F.V.R.—Within the past few months this officer has led his fighter squadron on a large number of varied sorties, including escorts to bomber formations which have attacked enemy shipping with much success. In all these operations 13 enemy aircraft have been destroyed and several others damaged. Much of the success achieved can be attributed to this officer's great skill and gallant leadership.

Wing Cdr. C. B. J. Porter, D.F.C., who has been awarded the D.S.O.

Flt. Lt. R. M. J. HOOPER, R.A.F.V.R., No. 161 Sqn.—This officer has completed a large number of sorties on his second tour of operations. He has at all times displayed the greatest keenness and his skill and unswerving devotion to duty have been reflected in the successes he has obtained. Flt. Lt. Hooper has set an example of the highest order.

F/O. A. H. RISELEY, R.A.F.V.R., No. 88 Sqn.—This officer has completed a very large number of sorties, many of them as air gunner in the earlier phases of the war. Latterly, in the role of pilot, he has taken part in many successful bombing attacks on such targets as airfields, railway junctions and industrial targets. He has displayed great skill, courage and devotion to duty.

Act. Wing Cdr. R. F. E. C. DEAN, D.F.C., R.A.F., No. 35 Sqn.—This officer has commanded his squadron with notable success over a long period. He has frequently taken part in operations over distant and dangerous targets in Germany, including Berlin, Cologne and Duisburg. He has at all times displayed the highest courage and keenness, whilst his enthusiasm and ability have been reflected in the excellent operational work performed by the whole squadron.

Second Bar to Distinguished Flying Cross

Act. Flt. Lt. J. A. MCCAIRNS, D.F.C., M.M., R.A.F.V.R., No. 161 Sqn.—Since being awarded a Bar to the D.F.C., Flt. Lt. McCairns has participated in a large number of successful operational missions. He is a model of efficiency, and his example of determination and devotion to duty have won great praise.

Bar to Distinguished Flying Cross

Act. Wing Cdr. L. J. JOEL, D.F.C., R.A.F., No. 55 Sqn.—Wing Cdr. Joel, now on his third tour of operational duty, has taken part in operations over East Africa, the Western Desert, Sicily and Italy. An excellent squadron commander, he has always evinced outstanding qualities of leadership and determination, attacking at low level in adverse weather to ensure accuracy of aim. During the evacuation of Sicily he led his squadron against the beaches of Messina, setting a fine example of courage and devotion to duty.

Act. Sqn. Ldr. H. H. BEALE, D.F.C., R.N.Z.A.F., No. 37 Sqn.—An excellent flight commander and captain of aircraft this officer has consistently displayed outstanding leadership, courage and resolution. Determined to complete his mission Sqn. Ldr. Beale on one occasion made repeated runs over the target before releasing the bombs despite enemy opposition. Another time, after a

successful attack upon an enemy airfield, executed in the face of intense searchlight and anti-aircraft defences, he was attacked by a Ju.88. With skill and coolness, Sqn. Ldr. Beale so manœuvred his aircraft that the rear gunner was able to shoot the enemy down.

Lt. Col. S. F. DU TOIT, D.F.C., S.A.A.F.—In November, 1943, this officer led a squadron in a low-level attack on an enemy landing ground in Yugoslavia. The attack was pressed home with vigour, and resulted in the destruction of four enemy aircraft; a number of others were damaged and two gun positions were silenced. By his gallant leadership, great skill and courage, this officer played a grod part in the success achieved.

Act. Sqn. Ldr. J. R. BALDWIN, D.F.C., R.A.F., No. 609 Sqn.—Sqn. Ldr. Baldwin is a keen, skilful and determined fighter. He has participated in much operational flying, during which he has destroyed at least nine enemy aircraft. In addition, he has attacked some fourteen locomotives, six barges, a tug and a tanker with damaging effect. He is a highly efficient squadron commander, whose example of courage and determination has inspired all

Wing Cdr. R. V. MCINTYRE, D.F.C., R.A.F., No. 100 Sqn.—As captain of aircraft, Wing Cdr. McIntyre has participated in numerous night bombing sorties over Northern, Western and Central Germany, including the heavily defended industrial targets in the Ruhr Valley. Since being awarded the D.F.C. he has continued to complete his sorties with determination, displaying a fine fighting spirit.

Distinguished Flying Cross

Act. Flt. Lt. S. TREVALLION, R.A.F.V.R., No. 278 Sqn.
P/O. R. A. SMITH, R.A.F.V.R., No. 10 Sqn.
Act. Sqn. Ldr. J. P. MABTLE, R.A.A.F., No. 450 Sqn.
Act. Sqn. Ldr. W. R. L. BEAUMONT, R.A.F.V.R., No. 219 Sqn.
Act. Sqn. Ldr. J. BROWN, R.A.F.V.R., No. 23 Sqn.
Act. Sqn. Ldr H. A. TURNER, R.A.F.V.R., No. 70 Sqn.
Capt. B. C. COWLE, S.A.A.F., No. 12 (S.A.A.F.) Sqn.
Lt. L. M. JACOBS, S.A.A.F., No. 12 (S.A.A.F.) Sqn.
Flt. Lt. R. T. SUSANS, R.A.A.F., No. 3 (R.A.A.F.) Sqn.
Flt. Lt. R. A. SWIFT, R.A.A.F., No. 27 Sqn.
Flt. Lt. H. A. S. WAGGETT, R.C.A.F., No. 23 Sqn. Sqn.
Flt. Lt. D. WHITE, R.A.F.V.R., No. 39 Sqn.
Act. Flt. Lt. R. E. BLAKE, R.A.F.V.R., No. 459 (R.A.A.F.) Sqn.
Act. Flt. Lt. E. A. BOYCE, R.A.F.V.R., No. 69 Sqn.
Act Flt. Lt. W. M. FRANKLIN, R.A.F.V.R., No. 27 Sqn
Act. Flt. Lt. R. J. H. HUSSEY, D.F.M., R.A.F.V.R., No. 72 Sqn.
Act. Flt. Lt J. A. L. JONES, R.C.A.F., No. 150 Sqn.
Act. Flt. Lt. O. H. LUSH, R.A.F.V.R., No. 70 Sqn.
F/O. L. G. BETTRIDGE, R.A.F.V.R., No. 150 Sqn.
F/O. G. L. BURTON, R.C.A.F., No. 114 Sqn.
F/O. W. G. CROSBY, R.A.A.F., No. 70 Sqn.
F/O. H. H. DEACON, R.A.F.V.R., No. 39 Sqn.
F/O. J. A. KEELING, R.A.F.V.R., No. 23 Sqn.
F/O. F. A. MELLORS, R.A.F.V.R., No. 111 Sqn.
F/O. J. E. PANNIFER, R.A.F.V.R., No. 681 Sqn.
F/O. K. B. ROGERS, R.N.Z.A.F., No. 150 Sqn.
F/O. M. T. S. RUMBOLD, R.A.F.V.R., No. 225 Sqn.
F/O. G. W. SMALL, R.A.A.F., No. 145 Sqn.
F/O. K. SMITH, R.A.F.V.R., No. 72 Sqn.
F/O. J. E. F. WRIGHT, R.A.F.V.R.
P/O. A. J. ADAMS, R.A.F.V.R., No. 111 Sqn.

SERVICE AVIATION

P/O. W. HALL, R.A.F.V.R., No. 159 Sqn.
P/O. L. MORAN, R.A.F., No. 142 Sqn.
P/O. J. G. SPENCE, R.A.A.F., No. 70 Sqn.
W/O. K. W. ADAMS, R.A.F.V.R., No. 223 Sqn.
w/O. W. E. BOTELEE, R.A.F., No. 159 Sqn.
Act. Flt. Lt. W. C. RICHES, R.A.F.V.R., No. 97 Sqn.

Conspicuous Gallantry Medal (Flying)

W/O. J. M. ALEXANDER, R.A.F.V.R., No. 7 Sqn.—Since December, 1940, W/O. Alexander has completed a large number of operational sorties, formerly in the Middle East and latterly against European objectives. He is an outstanding navigator, whose fine spirit of co-operation and devotion to duty have set a splendid example.

W/O. R. HAYWOOD, R.A.F., No. 7 Sqn.—W/O. Haywood has an outstanding operational record. An excellent wireless operator, he has served with distinction in both the European and Middle East theatres of war and attacked some of the most heavily defended targets in Germany and Italy, including Berlin, Peenemunde and Milan. At all times his courage and resolution in the face of the enemy have been exemplary, whilst his operational experience has been of great benefit to the squadron

Distinguished Flying Medal

Flt. Sgt. K. W. ELT, R.A.F.V.R., No. 405 (R.C.A.F.) Sqn.
Sgt. A. W. BEARD, R.A.F.V.R., No. 77 Sqn.
Sgt. W. PALMER, R.A.F.V.R., No. 77 Sqn.
Flt. Sgt. D. R. J. BARRELL, R.A.F.V.R., No. 159 Sqn.
Flt. Sgt. K. E. CLARKSON, R.A.A.F., No 72 Sqn
Flt. Sgt. H. S. ECCLESTON, R.A.A.F., No. 111 Squ.
Flt Sgt. C. SMITH, R.A.F., No. 159 Sqn.
Flt. Sgt. (now W/O.) M. J. SMITHSON R.A.F.V.R., No. 70 Sqn.
Sgt. H. HILL, R.A.F., No. 142 Sqn.
L.A/C. A. FOX, R.A.F.V.R., No. 681 Sqn.
Flt. Sgt. E. J. TROTTER, R.C.A.F., No. 101 Sqn
Sgt. H. E. HALL, R.A.F.V.R., No. 460 (R.A.A.F.) Sqn.
Flt. Sgt. J. R. BERRY, R.N.Z.A.F., No. 234 Sqn
Act. Flt. Sgt. W. D. COATES, R.A.F.V.R., No 97 Sqn.
Sgt. R. J. COOK, R.A.F.V.R., No. 625 Sqn.
Sgt. W. R. DICKINSON, R.A.F.V.R., No. 419 (R.C.A.F.) Sqn.
Flt. Sgt. J. O. BROOMFIELD, R.C.A.F., No. 462 (R.A.A.F.) Sqn.
Flt. Sgt. D. R. BROWNE, R.N.Z.A.F., No. 462 (R.A.A.F.) Sqn.
Flt. Sgt. T. CABLE, R.A.F.V.R., No. 156 Sqn.
Flt. Sgt. L. H. CRATE, R.A.F.V.R., No. 148 Sqn
Flt. Sgt. A. F. EMERSON, R.A.F.V.R., No. 61 Sqn

Far East

THE KING has been graciously pleased, on the advice of His Majesty's Australian Ministers, to approve the following awards in recognition of gallantry displayed in flying operations against the enemy in the South-West Pacific area :—

Distinguished Flying Cross

Flt. Lt. A. J. R. OATES, R.A.A.F.
F/O. J. H. SMITHSON, R.A.A.F.

THE KING has been graciously pleased to approve the following awards :—

B.E.M. (Mil.)

Sgt. F. B. WOOLCOCK, R.A.F.—Sgt. Woolcock was the coxswain of a pinnace which was standing by in the Suez Bay, when he received a message that a Beaufighter aircraft had crashed some 20 miles away He proceeded at full speed, and aided by aircraft, located two men who were by their dinghy on a desolate part of the coast. Owing to coral reefs, he was unable to approach closer than 250 yards from the shore. The aircrew members endeavoured to reach the pinnace in their dinghy, but were too exhausted to succeed in this, and the wind blew them back to the shore. Sgt. Woolcock then tried to send a lifebuoy on a line to the dinghy, but the line caught in the coral. Although he knew that sharks were common in these waters, Sgt. Woolcock, after instructing a senior deck hand to take charge of the pinnace, dived overboard and guided the launch as close to the reef as possible, and then swam to the dinghy on the shore. The two airmen then got in the dinghy and paddled while Sgt. Woolcock swam behind and pushed Having assisted the airmen safely on board the pinnace, Sgt. Woolcock swam back to the reef and freed the busy line. He was in the water for approximately threequarters of an hour and displayed fine courage and devotion to duty.

Cpl. A. W. VAN BLERK, S.A.A.F., S.A.M.C. attached to No. 7 (S.A.A.F.) Sqn.—In September, 1943, a Heinkel III attacked the airfield of Antimachia on Cos Island. During the attack an anti-personnel "butterfly" bomb crashed through the roof of the hospital and exploded Cpl. Van Blerk, although badly wounded in the chest by splinter, refused treatment, and continued to attend to the needs of other casualties until he collapsed. During the continuous enemy attacks against Cos this airman displayed courage and devotion to duty of a high standard.

Cpl. G. C. HARCOURT R.A.F.V.R No. 11 Squ.—In May, 1943, an aircraft which was attempting to land, crashed on the edge of the airfield and burst into flames. Cpl. Harcourt, a member of the service police, immediately gave orders for a fire tender to be brought to the scene. He then proceeded to the aircraft, which was burning furiously; the cannon shells in the wings were also exploding. Nevertheless, displaying complete disregard of his own safety, Cpl. Harcourt, with the assistance of an Army officer extricated the pilot from his cockpit and got him clear of the wreckage. He then endeavoured to strip him of his clothing, which was soaked in petrol and was burning.

Cpl. A. W. BLOOM, R.A.F.V.R.—One night in September, 1943, Cpl. Bloom was N.C.O. in charge of the fire tender when an aircraft crashed on an airfield and burst into flames. Cpl. Bloom led his party in an attempt to rescue the pilot, who was trapped in the blazing wreckage. Ignoring the imminent danger from the fire and exploding ammunition, Cpl. Bloom persisted in his efforts to release the pilot, and after some 15 minutes the latter was successfully extricated and his life saved. Cpl. Bloom has, by his prompt action on other occasions, saved crashed aircraft from becoming total losses.

L.A/C. R. D. C. CARTER, R.A.F.V.R., No. 227 Sqn.—In August, 1943, when a grass fire started near to a technical stores, L.A/C. Carter, who was in charge of the fire tender, at once proceeded to the scene. The fire soon surrounded a large store of gelignite and other explosives; one head of gelignite was already burning. Despite the grave danger of an explosion occurring, L.A/C. Carter conducted the fire fighting, working very close to the burning explosives. After the work had proceeded for about five minutes the burning gelignite exploded, injuring all the fire crew and rendering the fire tender unserviceable.

Foreign Decorations

THE KING has granted unrestricted permission for the wearing of the undermentioned decorations conferred upon the personnel indicated in recognition of valuable services rendered in connection with the war :—

Conferred by the President of the United States of America

Legion of Merit (Legionnaire)

L.A/C.W. I. G. LEASK, W.A.A.F

Distinguished Flying Cross

Wing Cdr. P. R. MAY, A.F.C., R.A.F.
Wing Cdr. A. B. WILKINSON, R.A.F.V.R.
Act. Wing Cdr. D. R. BAGNALL, D.S.O., D.F.C., R.A.F.O.
Act. Wing. Cdr. A. C. DEERE, D.S.O., D.F.C., R.A.F.O.
Act. Wing Cdr. J. E JOHNSON, D.S.O., D.F.C., R.A.F.V.R.
Act. Wing Cdr. J. F. NEWMAN, D.F.C., R.A.F.O.
Act. Wing Cdr. A. WARBURTON, D.S.O., D.F.C., R.A.F.V.R.

Air Medal

Act. Wing Cdr. S. L. RING, D.F.C., R.A.F.O.
F/O. L. MCMILLAN, R.C.A.F.
F/O. D. G. SCOTT, R.C.A.F.
Flt. Sgt. J JEARDEN, R.A.F.V.R.

Roll of Honour

Casualty Communiqué No. 344.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list, 117 are second entries giving later information of casualties published in earlier lists.

Group Capt. W. E. Oulton, D.S.O., D.F.C., commanding officer of an R.A.F. station in the Azores.

SERVICE AVIATION

Royal Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. R. E. C. Allen; Flt. Sgt. J. Anderson; Sgt. E. J. Andrew; Sgt. L. P. Barnett; Sgt. A. K. Brodie; P/O. D. E. Sharpe; Sgt. P. Smith; Flt. Sgt. J. Stupart; Sgt. C. C. Watts.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. E. Airey; Sgt. W. F. Ambler; Sgt. R. A. Asbury; Sgt. S. A. J. Bailey; W/O. T. W. Barker; F/O. A. E. B. Barnard; Flt. Sgt. A. Bowers; Flt. Sgt. R. L. Castellari; Sgt. J. G. Chalmers; F/O. A. Cheetham; Sgt. C. N. Clay; Flt. Sgt. L. Copley; Flt. Sgt. A. Cox; Sgt. D. W. Creevy; W/O. G. A. Davie; Sgt. D. O. Dowson; F/O. H. Duro; F/O. J. H. Elder; Sgt. H. Elliott; Sgt. J. E. Elwell; Sgt. R. O. Eynon; Sgt. N. S. Farr; Sgt. J. P. Fitchett; Act. Flt. Lt. N. J. Gardner; Sgt. K. F. Green; Sgt. P. J. W. Grimwood; Sgt. E. Hall; Sgt. T. F. Hayden; Sgt. K. W. Haynes; Sgt. L. W. Hayward; Flt. Sgt. G. F. Hogan; F/O. C. B. Hooper; Sgt. G. W. Houliston; Sgt. P. H. R. Hunt; Sgt. D. F. Inch; P/O. R. R. Johnston; Sgt. J. Jones; Sgt. W. G. Kirby; Flt. Sgt. C. W. Kleynhans; P/O. A. C. Knee-shaw; Sgt. G. E. Lee; Flt. Sgt. A. G. McGuire; Sgt. C. J. H. MacKenzie; Sgt. J. B. A. McPherson; Flt. Sgt. P. L. Mansfield; W/O. B. Marrows; Sgt. J. Martland; F/O. D. H. W. Morgan; Sgt. S. S. Morrow; Sgt. R. M. Mumme; Sgt. J. H. Nunn; Sgt. G. E. Pascoe; Sgt. A. D. Pennycord; Flt. Sgt. P. E. Poulson; Sgt. E. T. Powell; Sgt. R. G. Prince; Sgt. T. F. Richardson; Sgt. R. Rutherford; Flt. Sgt. S. J. G. Rutherford; Flt. Sgt. L. C. Schroeder; Sgt. P. H. Sheerman; Sgt. E. Short; Sgt. F. Simpson; Sgt. K. Stainton; Flt. Sgt. R. J. Steele; Sgt. J. A. Stewart; Sgt. A. C. Wade; Sgt. V. Walters; Sgt. J. C. Walton; Sgt. F. G. Ward; Sgt. S. Westwoods; Sgt. D. E. Whitaker; P/O. S. M. Wood; Sgt. R. G. Woodfield.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Sgt. G. J. Broughton.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. W. Allen; A/C.2 H. R. Ares; P/O. J. Bennett; Sgt. W. Brown; F/O. A. Davis; Sgt. W. Eaton; W/O. J. H. Gillies; Sgt. L. L. Green; A/C.2 J. D. Hames; F/O. B. Hamilton; L.A/C. P. G. Hodgkins; A/C.2 R. Hurley; Sgt. S. C. Johnson; A/C.2 W. Kennedy; Sgt. J. W. Molesworth; Flt. Sgt. W. N. Owen; Flt. Sgt. T. W. Pearman; Sgt. J. B. Reilly; Sgt. J. Robertson; A/C.2 D. Shaw; W/O. G. E. Shield; Sgt. L. E. Terry; F/O. J. V. Tyler; A/C.2 A. E. Work.

MISSING.—Sgt. A. Ackland; Flt. Sgt. R. W. Aitken-Quack; Sgn. Ldr. K. A. Aldridge, D.F.C.; Flt. Sgt. T. L. Anderson; P/O. W. Anderson; Sgt. C. J. Ashton; Flt. Sgt. G. A. Atkinson; F/O. D. M. Bell; Flt. Sgt. R. S. Bennett; Sgt. M. Bools; Sgt. W. R. Boncher; Flt. Sgt. T. W. Boynton; Sgt. W. D. Bracken; P/O. J. W. Brown; Act. Flt. Lt. F. P. Burbridge; Flt. Sgt. B. G. Burton; Sgt. R. A. Campbell; Sgt. A. G. Chandler; Sgt. D. Clark; Flt. Sgt. W. E. Coates; Sgt. J. R. Colebrooke; F/O. F. A. Collins; Sgt. N. P. Cook; Sgt. J. R. Cowen; Sgt. L. A. Crooks; Sgt. F. E. Deavin; W/O. S. G. Dorrell; Sgt. J. S. Edwards; Sgt. G. F. A. E. J. Falck; Sgt. B. H. Farndell; Sgt. R. T. Fathers; Sgt. R. M. Fisher; Sgt. P. H. Fryer; Sgt. F. A. Fuller; Sgt. D. Gadsden; Sgt. J. Graham; F/O. W. C. Grimes; F/O. T. Hall; F/O. C. K. Hanscomb; Sgt. J. Harris; Act. Flt. Lt. C. V. Harvey, D.F.C.; Sgt. J. W. Harvey; Sgt. G. Hawgood; Sgt. S. T. Hazell; Sgt. W. Hazeldine; W/O. H. H. Hill; Flt. Sgt. R. O. Hiscock; F/O. A. Hopkins; Flt. Lt. J. A. Hoskin; Sgt. D. H. Hughes; Sgt. H. A. R. Hurn; F/O. J. D. Johnston; F/O. C. E. Jones; Sgt. W. B. Jones; Sgt. J. C. Jossa; Flt. Sgt. J. H. Jowett; Sgt. G. Kemp; Flt. Sgt. F. P. King; Sgt. S. Knight; Sgt. C. Langley; F/O. C. S. Laxton; Sgt. N. N. Lewis; Sgt. W. E. Lloyd; Sgt. A. G. Lovsay; Flt. Sgt. A. Low; Sgt. W. McKay; Sgt. A. P. McKee; Sgt. A. J. Mathieson; Sgt. W. J. M. Middleton; F/O. E. R. Mitchell, D.F.M.; Flt. Sgt. R. S. Mortham; Sgt. R. A. Park; Flt. Sgt. A. N. Partington; F/O. H. C. Pavitt; Flt. Sgt. J. A. Penny; Sgt. J. M. Phillips; Sgt. K. G. Plummer; F/O. R. A. Quinney; Flt. Sgt. J. C. E. Rees; Sgt. A. Reeves; Flt. Sgt. R. I. MacK. Richards; Flt. Sgt. S. P. Rogers; Sgt. W. Rowland; W/O. J. H. Saxton; Sgt. A. A. M. Seaman; Sgt. R. G. B. Shea; Sgt. W. R. Silcocks; Act. Flt. Lt. A. J. W. Silk; Sgt. G. L. Skelton; Flt. Sgt. H. Smith; P/O. L. A. Smith; Flt. Sgt. J. Smith; Flt. Lt. G. Soulsby; Sgt. N. G. Speight; Sgt. J. T. Sykes; Sgt. G. Tabenor; Sgt. D. W. Timms; F/O. A. J. Trenerry; Flt. Sgt. J. N. Underwood; Sgt. H. S. Waller; Flt. Sgt. W. G. Waller; Flt. Lt. A. G. Warren; Sgt. C. Watson; F/O. H. J. Whitticks; P/O. S. J. Whittingham; Flt. Sgt. R. G. Williams; Sgt. A. Wilson; Sgt. J. R. Wilson; F/O. N. W. Wright; Sgt. R. S. Yates; Act. Flt. Lt. E. E. G. Youseman; Flt. Sgt. P. R. Zanchi; Sgt. W. P. Zastrow.

KILLED ON ACTIVE SERVICE.—F/O. R. Bailes; Sgt. J. F. Fearnley; L.A/C. D. Geldart; Sgt. T. P. T. Oliver; Sgt. L. Pettit; P/O. N. F. C. Winby.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. J. R. Wells.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. G. R. Cope; F/O. H. L. Gordon.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. A. E. Chapman, Flt. Sgt. D. H. Crouch; Flt. Sgt. D. Douds; Sgt. D. S. Finlason; Sgt. A. A. Prowse.

MISSING, BELIEVED KILLED IN ACTION.—F/O. E. F. McEgan; Flt. Sgt. F. A. Williams.

MISSING.—Flt. Sgt. L. A. Hastings; F/O. R. H. MacDonald; Flt. Sgt. D. C. Morley; P/O. M. M. Patrick; P/O. W. H. Rose, D.F.C.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. G. E. Campbell; Sgt. J. J. F. Holland; Sgt. B. H. Nickel; Flt. Sgt. K. L. Spring; Flt. Sgt. H. G. Watson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. H. M. Batters; P/O. S. A. Bishop; Wing Cdr. L. S. Ford, D.F.C.; Flt. Sgt. D. R. Gilchrist; F/O. M. D. S. Hicks; P/O. R. J. Lee; Flt. Sgt. F. J. V. Levesque; Flt. Sgt. T. M. Moran; F/O. T. H. O'Connell; Sgt. H. Richmond; P/O. J. A. Simpson; F/O. A. Smith, D.F.C.; Sgt. A. A. Tshantre.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. W. E. Ackland; Act. Flt. Lt. F. Halliday; P/O. S. M. Kent; F/O. R. R. MacGregor; Sgt. G. L. MacKay; Flt. Sgt. J. A. Smart.

MISSING.—Sgt. H. L. Anderson; F/O. I. Armitage; F/O. G. C. Bailey; Flt. Sgt. N. Barrett; Flt. Sgt. F. G. Benning; W/O. N. R. Bowman; Flt. Sgt. C. E. Byers; P/O. C. M. Cottingham; Sgt. M. F. Donaldson; Flt. Sgt. P. W. Dries; F/O. C. G. Gorrie; F/O. A. F. Hague; Sgt. L. G. Hanton; Flt. Sgt. C. L. Hartman; W/O. W. Hill, D.F.M.; Sgt. G. A. Howitson; Flt. Sgt. W. L. Hunter; Flt. Sgt. J. M. Jacob; F/O. W. S. Johnson; P/O. A. MacN. Laughland, D.F.M.; W/O. J. A. Lesage; Sgt. M. A. McKellar; Sgt. G. A. May; P/O. J. R. Mayo; Sgt. N. H. Michie; Act. Flt. Lt. J. F. Munro, D.F.C.; P/O. R. J. Newman; W/O. J. B. D. O'Grady; Sgt. H. E. Petersen; F/O. L. Plishka; Flt. Sgt. A. B. Radbourne; F/O. R. B. Richard; Flt. Sgt. H. C. Shepherd; F/O. S. M. Smith; Flt. Lt. H. W. J. Stewart, D.F.C.; F/O. R. H. Strauss; Flt. Sgt. R. C. Strickland; Flt. Sgt. W. Sweeney; Flt. Sgt. B. V. Tedford; Flt. Sgt. J. G. Tomlinson; F/O. J. D. B. Ulrickson; W/O. J. J. Zunti.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. M. S. Gilberd; Flt. Sgt. E. H. Howell; Sgt. F. W. Marshall; Sgt. J. W. Smith.

MISSING.—P/O. R. Florence.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. A. E. Kemp.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED PRISONER OF WAR.—F/O. A. R. Ball.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—P/O. R. E. Dodd; P/O. J. T. R. Taylor.

Officers of the Chinese Military Mission in the Middle East being shown the "dropping well" in a paratroop Wellington.

Casualty Communique No. 345

Of the names in this list 119 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Sgt. M. V. Aungier; Sgt. H. G. Boswell; Sgt. R. Carr; Sgt. L. H. Cartwright.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Lt. J. W. N. Bailey; P/O. P. S. Bastian; Sgt. T. Crossland; Flt. Lt. L. J. Davies; Sgt. I. R. Elliot; F/O. G. Fox; Sgt. T. Galloway; Flt. Sgt. A. Greene; Sgt. R. W. Hedicker; Sgt. N. S. Pinkney; Sgt. J. W. R. H. Woodley.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. Appleton; Sgt. F. J. Armstrong; Sgt. J. D. Armstrong; Sgt. J. G. Baker; Flt. Sgt. L. W. Baldwin; Sgt. A. G. Ballantyne; Flt. Sgt. E. W. Banks; Sgt. R. A. Beaton; Sgt. R. F. Bell; Sgt. W. F. Biggs; F/O. J. D. Bishop; Flt. Sgt. R. G. Brett; Flt. Sgt. J. Brister; Sqn. Ldr. G. A. Brown; Sgt. N. Bruce; F/O. F. R. F. Chapman; Sgt. O. H. D. Cook; Act. Flt. Lt. W. E. Davey; Flt. Sgt. H. Davidson, D.F.M.; Sgt. T. R. Davidson; F/O. R. F. Downes; Sgt. T. K. Edwards; Sgt. D. L. N. Eggleton; F/O. M. A. S. Elliott; Sgt. D. H. Evans; Sgt. F. W. Featherstone; Sgt. R. R. Fox; P/O. I. T. S. Fulton; P/O. F. Giles, D.F.M.; Flt. Sgt. W. E. B. Gunn; Sgt. R. C. L. Guest; Sgt. G. J. C. Hall; Flt Lt. E. T. Halley; Sgt. E. G. Hammett; Sgt. K. C. Harrison; Sgt. D. R. Higgs; Sgt. R. C. Hitchcock; Sgt. A. R. Hobbs; Sgt. A. Holden; F/O. A. M. Houston; Act. Flt. Lt. S. G. Howe, D.F.C.; Flt. Sgt. H. Hudson; Sgt. T. V. Hughes; P/O. H. F. Jolley; Sgt. E. J. Kimberley; Sgt. L. J. C. King; Sgt. C. W. E. Leach; Sgt. K. G. C. Legg; P/O. J. G. McCauley; Sgt. D. McKenzie; Sgt. E. C. McMillan; F/O. A. W. Marsden-Levy; Sgt. D. H. Melville; Sgt. R. S. G. Miller; F/O. W. N. Mounsey; Flt. Sgt. J. J. O'Brien, D.F.M.; Sgt. R. J. O'Brien; Sgt. J. J. O'Neill; P/O. D. C. Payne; F/O. R. A. Phillips; Sgt. H. Pierpoint; Sgt. K. A. Pinchin; Act. Flt. Sgt. T. J. Pritchard; Sgt. C. D. Reed; F/O. H. H. Rogers, D.F.M.; P/O. G. Seall; P/O. J. L. Shiells; Sgt. F. J. Skeeles; Sgt. C. M. Skelton; Sgt. B. W. Somerford; Sgt. J. C. Stewart; Sgt. F. J. Stoker; Sgt. J. R. Tait; F/O. T. C. Timney; P/O. D. A. S. Tomkins; Sgt. E. H. Tucker; Act. Sqn. Ldr. L. Verdon Roe, D.F.C.; Sgt. P. Wadding; Flt. Sgt. T. K. Wagstaff; Sgt. A. Walker; Sgt. L. R. Wallace; F/O. L. C. Wheeker; Sgt. R. F. Whitaker; F/O. W. B. Whitaker; Sgt. B. T. White; Sgt. W. F. Whitfield; Sgt. K. Wilcock.

WOUNDED OR INJURED IN ACTION.—Sgt. R. R. Hartley.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. H. Beane; Sgt. W. Dwyer; Sgt. J. Mackay; Sgt. F. Macpherson; Sgt. L. A. Williamson.

MISSING.—Flt. Sgt. R. T. Abbott; Sgt. A. V. Baker; Sgt. G. E. J. Ballard; Sgt. W. Bell; Sgt. W. Belton; Sgt. F. R. Birks; Sgt. N. Bolt; Sgt. G. Bowering; Sgt. T. G. Brady; Sgt. R. H. Bussell; Flt. Sgt. R. Butler; Sgt. J. A. Callaway; Sgt. F. C. Diggle; F/O. A. W. Douglas; Sgt. L. F. Eyre; Sgt. H. H. Falls; Flt. Sgt. G. Fielding; Sgt. E. L. Foulkes; Sgt. P. Gallagher; Flt. Lt. S. A. H. Glasspool; Sgt. B. L. Gooding; F/O. G. F. R. Green; Sgt. W. A. Green; F/O. G. H. R. F. Harris; Flt. Sgt. J. H. S. Harsley; Sgt. J. R. Henderson; F/O. J. J. Howe; Sgt. D. J. Howell; Sgt. R. Jeffreys; Sgt. C. Johnson; Sgt. R. G. Jones; Sgt. H. G. King; Flt. Sgt. N. King; Sgt. C. F. Kirsch; Sgt. W. McGray; Sgt. J. H. McIvor; Sgt. W. J. McLean; Sgt. A. H. Masters; Sgt. F. Matthews; P/O. L. H. Matthews; Sgt. W. E. T. Michell; Sgt. T. A. Monk; Sgt. R. F. Nelson; F/O. W. R. E. North, D.F.C.; F/O. D. H. P. O'Brien; F/O. P. R. Paice; Sgt. J. Pallanca; Flt. Sgt. R. H. Pennells; Flt. Lt. P. J. M. Prangley; P/O. F. D. Rawlines; Sgt. R. Redfern; Sgt. L. L. Richards; Sgt. A. W. Roberts; Flt. Sgt. W. G. F. Saddler; Sgt. K. G. Smith; W/O. S. T. Stacey; F/O. A. J. Sumner; Sgt. G. U. Topp; Sgt. T. Wainwright; Sgt. R. N. Walne; Sgt. A. E. Ward; Sgt. C. W. D. Watts; Sgt. L. Webb; Flt. Sgt. L. White; Sgt. J. D. Whittingham; P/O. H. R. W. Whittle; Sgt. F. Wilkinson; F/O. E. B. Woolhouse.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. G. A. Bennett; F/O. J. B. Knight; F/O. P. Waite.

KILLED ON ACTIVE SERVICE.—Sgt. R. E. C. Bacon; L.A/C. J. Barnes; L.A/C. N. Cheetham; L.A/C. T. B. R. Crossthwaite; F/O. H. McCarthy; Sgt. G. H. Manley; F/O. R. Mercer; Sgt. D. E. Phillips; Sgt. T. E. Robinson; Sgt. C. A. Stout; Sgt. B. F. Taylor; Sgt. J. Tittering-ton; F/O. J. Tomalin; Sgt. A. J. Winton; F/O J. Wyllie.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. A. D. Edmondson; Sgt. R. Farnsworth; Flt. Lt. A. M. Wodehouse.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED ON ACTIVE SERVICE.—Flt. Sgt. H. Beaumont.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. C. E. Goodman.

SERVICE

PREVIOUSLY REPORTED WOUNDED OR INJURED ON ACTIVE SERVICE, NOW REPORTED DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Sgt. R. Duckworth.

DIED ON ACTIVE SERVICE.—A/C.2 F. J. Bailey; L.A/C. J. H. Brundell; Sgt. D. H. Craigie; Sgt. T. Hillier; L.A/C. J. T. Nicholas; L.A/C. L. C. Partridge; L.A/C. W. T. E. Potter; L.A/C. D. Ritchie; L.A/C. T. G. Tobias.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. J. S. Caton; Sgt. A. McN. Cowe; Sgt. R. H. Hale; Flt. Lt. D. Haywood; Flt. Sgt. S. Powell; Sgt. A. S. Soutar; Flt. Sgt. J. McK. V. Thomson.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—Cpl. M. W. McDowell.

Royal Australian Air Force

KILLED IN ACTION.—Act. Sqn. Ldr. S. G. Welshman, D.F.M.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. E. H. Finch.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. R. M. Austin.

MISSING.—Flt. Sgt. L. P. Barber; F/O. G. W. B. Bye; Flt. Sgt. V. Collins; F/O. E. R. Critcher; F/O. J. J. Dupont, D.F.M.; F/O. K. V. Hore; Act. Flt. Lt. D. S. P. Howe; Flt. Sgt. W. K. Moritz; Flt. Sgt. J. H. Poulton; Flt Sgt. J. H. Royal; Flt. Sgt. E. J. Stones; Flt. Sgt. L. G. Studman; P/O. G. Y. Temple; F/O. W. J. Withers.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. W. Marshall.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. L. Woods.

Royal Canadian Air Force

KILLED IN ACTION.—W/O. A. Aikman; F/O. J. J. Blanchfield; F/O. G. L. Huffman; P/O. H. Lowe; Flt. Sgt. C. D. Manders.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. A. Cook; F/O. T. M. Pethick.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. W. R. Hewitt; Sgt. H. P. Spencer.

WOUNDED OR INJURED IN ACTION.—Act. Flt. Lt. J. B. Cleveland; Flt. Sgt. W. G. Martin.

MISSING, BELIEVED KILLED IN ACTION.—P/O. R. H. Davis; F/O. D. L. Pickard; F/O. J. W. Wiley.

MISSING.—Flt. Sgt. G. P. Armstrong; Sgt. G. D. Arnott; Flt. Sgt. H. J. Beattie; Flt. Sgt. E. J. Berndt; F/O. W. R. Bloch; P/O. W. H. Boles; F/O. G. H. Buchanan; F/O. E. A. Burton; F/O. M. R. Cantin; Sgt. E. W. Chalk; Flt. Sgt. S. E. Clarke; Flt. Sgt. H. J. L. Copping; Flt. Sgt. K. G. Davis; Flt. Sgt. J. V. Dillon; Flt. Sgt. J. M. D. J. Dugas; F/O. B. Emmerson; W/O. A. T. Gardiner; Flt. Sgt. E. L. Guertin; Flt. Lt. V. Y. Haines; F/O. D. A. Hogg; Act. Sqn. Ldr. A. J. Hughes; Flt. Sgt. C. J. E. Kindt; P/O. J. D. Lynch; Flt. Sgt. P. T. McCallum; Flt. Sgt. A. S. MacDonald; Flt. Sgt. N. W. McNair; F/O. R. McSorley; Act. Wing Cdr. A. C. Mair; F/O. C. M. Mair; Sgt. D. J. Metz; P/O. K. R. G. Millar; F/O. W. A. Mitchell; Flt. Sgt. S. R. Moncrieff; W/O. D. R. Nelson; Flt. Sgt. S. J. Ouellette; P/O. M. Rabinovitch; Flt. Sgt. K. W. Sawyer; P/O. D. G. Scott; Flt. Sgt. J. R. R. Small; W/O. D. MacM. Smith, D.F.M.; Flt. Sgt. S. E. Smith; F/O. J. J. Thurmeier; Flt. Sgt. S. R. Troman; Sgt. J. L. Truax; Flt. Sgt. L. P. Webster.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. B. V. Chevalier; Sgt. J. E. J. C. Dubord; Flt. Sgt. J. J. MacGillivray; Sgt. B. R. Minson; Flt. Sgt. R. F. Morand; Flt. Sgt. J. J. J. Vennes.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. T. V. Gagnon; F/O. J. A. Hill.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED PRISONER OF WAR.—Flt. Lt. W. L. Murphy.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—W/O. J. M. G. Cantin; W/O. W. L. Sleeman.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. N. A. McMillan.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. Blaylock; Flt. Sgt. L. R. Slatter.

DIED ON ACTIVE SERVICE.—Flt. Sgt. L. E. Tate.

South African Air Force

KILLED ON ACTIVE SERVICE.—2/Lt. R. C. Nell.

Casualty Communiqué No. 346

Of the names in this list 111 are second entries, giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Flt. Sgt. T. Butterfield; Flt. Sgt. G. Chalmers; Sgt. R. W. Davison; Flt. Sgt. J. Graham; F/O. R. C. Henderson; Flt. Sgt. A. Huddlestone, D.F.M.; Sgt. R. E. Jones; Sgt. J. C. Knox; Sgt. D. I. T. Munn; F/O. D. F. Robins; Sgt. J. G. Smart; Act. Wing Cdr. D. C. B. Walker; F/O. K. E. Warwick.

"Our cannon speak our thoughts." The crest of No. 157 Squadron, R.A.F.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. A. Brown; Sgt. S. Busby; Sgt. W. J. Chambers; Sgt. W. E. Cunliffe; Sgt. W. P. Davis; Sgt. A. A. Gill; Sgt. B. Kermode; Sgt. J. C. McPhedran; Sgt. F. N. Pink; Sgt. C. A. Richardson; Flt. Sgt. H. Shepherd; Sgt. L. Stephenson; P/O. L. G. Weller.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. J. L. Atha; Sgt. R. F. P. Baggaley; Sgt. K. Benjamin; Sgt. A. M. H. Black; P/O. F. E. Booy; F/O. W. C. Brisbane; Sgt. T. L. Bromley; Sgt. K. R. Burton; D.F.M.; Sgt. S. G. Coleman; Sgt. N. S. Collins; Sgt. F. W. Cooper; Sgt. C. B. Dear; Sgt. D. J. Druett; Sgt. W. J. Erdbeer; Sgt. E. Farmen; P/O. H. C. Fiddes; Sgt. A. W. Fincham; Sgt. H. Fortune; Sgt. D. F. Gage; Sgt. S. N. Goddard; Sgt. F. L. Godden; Sgt. H. G. Graham; Sgt. H. Green; F/O. T. H. Green; Sgt. J. W. Greenwood; Flt. Sgt. J. Grindley; Sgt. F. J. Hackett; Sgt. A. Hall; Flt. Sgt. G. Hamilton; Sgt. G. Henderson; Sgt. J. S. Hetherington; Sgt. J. T. Hindley; Sgt. R. L. Hodgson; Sgt. R. C. Horton; Sgt. G. W. C. James; F/O. R. N. Johnson; Sgt. A. E. Jones; Sgt. G. W. Jones; Flt. Sgt. A. E. King; F/O. C. R. Lawrence; Sgt. W. J. Ledbury; Sgt. L. W. L. Llewellyn; Sgt. R. W. Lynn; Flt. Lt. G. B. MacLachlan; Sgt. D. Maynard; P/O. A. Metcalf; Sgt. G. Myers; Sgt. J. Palmer; Sgt. E. J. Peacock; Sgt. H. A. Ramsey; Sgt. H. Ray; Sgt. J. P. Redmond; Sgt. J. P. Roughan; Sgt. E. J. Sayer; Sgt. J. Simmons; P/O. W. A. Smith; Sgt. J. Staniforth; Sgt. B. E. Taylor; Sgt. R. A. Tilbury; Sgt. G. Wade; Sgt. M. Watson; Sgt. H. J. Webb; Sgt. W. L. Whitehouse; Sgt. T. J. Woodward.

WOUNDED OR INJURED IN ACTION.—Sgt. C. L. Jennings; Sgt. F. Taylor.

PREVIOUSLY REPORTED MISSING, NOW REPORTED DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Flt. Sgt. A. Whiting.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. S. O. J. Boxshall; Flt. Lt. G. Goldsmith; F/O. F. D. K. Howe-Browne; Sgt. H. Johnson; W/O. L. Lawrence; Sgt. S. W. Pritchard; Sgt. G. H. Reveley; Sgt. J. L. Selkirk; Sgt. E. Smith; Flt. Sgt. W. A. Walke; Sgt. R. S. Ward; Sgt. P. E. Wells.

MISSING.—Cpl. S. H. Anderson; Sgt. G. W. Arlett; Flt. Lt. C. T. Bassage; Sgt. F. E. Beattie; Flt. Sgt. H. S. Bennett; Flt. Sgt. C. E. Bishop; Sgt. J. Broadhurst; Sgt. L. C. Brown; Sgt. C. Butler; Flt. Sgt. H. L. Clayton; Sgt. J. F. Cole; Flt. Sgt. D. L. Cooper; Sgt. G. H. Cooper; Sgt. C. C. Corrie; P/O. F. G. Cox; Sgt. W. A. Cox; Sgt. D. G. Craig; Flt. Sgt. D. E. L. Grosse; Sgt. J. P. Dalton; Sgt. W. Dowson; P/O. A. U. Duncan; Sgt. J. H. Duncan; P/O. L. J. Ellis; Sgt. L. W. Fisher; Sgt. A. H. Forward; Sgt. E. L. French; Flt. Sgt. K. Garnett; Flt. Sgt. T. J. Gosling; Sgt. W. E. Gough; Sgt. I. F. Groves; P/O. E. T. Hargreaves; Flt. Sgt. W. W. Harrington; F/O. A. W. Hazell; Sgt. G. H. Kaye; Sgt. K. G. V. Keir; Sgt. H. G. Keymer; P/O. P. A. Lee; P/O. R. A. Lewis; Flt. Sgt. S. V. Moss; Sgt. D. J. Nuttman; P/O. D. Park; P/O. E. H. Patrick; Sgt. L. Price; Flt. Sgt. W. E. Robinson; Sgt. R. Roxby; Sgt. J. W. Scott; Sgt. P. J. Smart; Flt. Sgt. F. Smith; Flt. Sgt. J. M. Smith; Flt. Sgt. W. J. Smith; Sgt. R. Smithers; Act. Flt. Lt. B. J. Staniland; Act. Flt. Lt. W. A. L. Swan; P/O. E. H. Tansley; F/O. E. A. Taylor; Sgt. E. A. Topham; Sgt. F. Turner; Sgt. P. W. Walker; P/O. J. F. Ward; Act. Flt. Lt. R. F. Wells; F/O. G. A. West; Sgt. A. Wiles; Sgt. A. Woodley; Sgt. W. A. Young.

KILLED ON ACTIVE SERVICE.—L.A/C. F. Bedford; Sgt. G. A. Bennett; Flt. Sgt. D. T. Bromhead; Sgt. G. A. Chilvers; Flt. Sgt. D. C. Douglas; Sgt. J. A. Duddridge; F/O. H. O. Dransfield; Sgt. R. E. Harris; Sgt. B. K. Hatch; Sgt. [illegible] Hunter; F/O. D. Leeke; L.A/C. E. Lowson; Sgt. W. J. Morgan; L.A/C. T. O. C. Pouyat; Sgt. R. E. Rand; Sgt. T. J. Skyrme; Sgt. L. Slater; Sqn. Ldr. P. M. H. Thomas; Flt. Sgt. W. G. Thomson; Sgt. C. G. E. Wellington; Sgt. G. Wilkinson; Sgt. J. O. Winters; L.A/C. M. A. Young.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—L.A/C. A. L. Smillie.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. W. Alexander; Flt. Lt. R. F. Oakes; F/O. R. J. Russell.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Sgt. F. W. Rutherford.

DIED ON ACTIVE SERVICE.—L.A/C. F. W. Beadman; Cpl. S. Border; Flt. Lt. H. A. Chapman; L.A/C. A. C. Convey; A/C.2 T. Cummings; F/O. J. A. Hewitt; A/C.1 J. C. Richards; Cpl. W. Sizer; A/C.2 R. J. Walker.

AVIATION

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. C. M. Hills.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—W/O. W. W. Collens; Flt. Sgt. J. L. Forrest; Flt. Sgt. N. R. Goudie; Flt. Sgt. N. T. Mason; Flt. Sgt. J. V. O'Loughlin.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. N. J. Edmonds; P/O. R. E. Inglis; W/O. R. K. Thomas; W/O. R. R. Wicks; W/O. K. A. Wood.

MISSING.—Act. Flt. Lt. T. D. H. Alford; Flt. Sgt. J. M. Booth; F/O. J. O. Boyd; Flt. Sgt. A. J. J. Brown; P/O. G. Bushell; Flt. Sgt. R. D. Cole; P/O. A. T. S. Collier; Act. Flt. Lt. E. G. M. Corser, D.F.C.; W/O. A. E. Daley; Flt. Sgt. N. L. Ginn; Flt. Sgt. L. W. L. Godfrey; Flt. Sgt. M. N. Jennings; Sgt. M. W. Jones; W/O. L. A. Kent; F/O. A. R. Mitchell; Flt. Sgt. I. R. Phelan; Flt. Sgt. R. E. D. Richards; Flt. Sgt. L. R. Simpson; Flt. Sgt. D. R. G. Taskis.

KILLED ON ACTIVE SERVICE.—Sgt. J. A. Batteham; Flt. Sgt. M. S. Beyer; Flt. Sgt. R. F. Canavan; F/O. C. C. Cooper; F/O. E. H. Lawrence; F/O. F. Moss; Flt. Sgt. V. F. Suttor.

Royal Canadian Air Force

KILLED IN ACTION.—Flt. Sgt. M. J. Lindsay; Flt. Lt. A. W. Pilcher; F/O. A. E. Shaw; Flt. Sgt. W. H. Wade.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. K. B. Davidson; Sgt. F. C. Emor.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. D. S. Brown; Flt. Sgt. H. E. Budd; Flt. Sgt. M. E. Bunn; Flt. Sgt. G. D. Coe; P/O. G. H. Debruzac; P/O. J. H. Edwards; F/O. W. A. Follows; Flt. Sgt. A. E. Fowell; P/O. S. H. K. Goodyear; P/O. A. G. Grant; P/O. B. D. King; Flt. Sgt. J. M. R. Lang; P/O. R. I. Law; Act. Flt. Lt. A. R. McCallum; P/O. M. Mank; P/O. W. G. Milne; Sgt. H. D. Oke; W/O. D. E. Palmatier; P/O. K. M. Piche; Flt. Sgt. J. T. Roy; Sgt. L. D. Ryan; P/O. M. B. Spence; Sgt. R. V. Stuart.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. L. B. Owen.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. M. Beatty; F/O. H. D. Blair; Sgt. J. H. Catte; F/O. J. A. Foulston; Flt. Sgt. P. R. Gray; Flt. Sgt. E. G. Johnston; P/O. W. J. Taylor; P/O. D. C. Walker; Flt. Sgt. J. Wallace.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. W. H. Abraham; P/O. R. G. Locke; F/O. A. H. Russell.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. H. B. Bellew.

DIED ON ACTIVE SERVICE.—W/O. K. O. Perry.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. C. F. Blanchard.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. T. W. J. Denholm.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. O. A. Burton; Flt. Sgt. R. J. Wardrop.

South African Air Force

KILLED ON ACTIVE SERVICE.—Lt. Slater.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P.Plt. T. M. Smith.

Official Correction

Casualty Communiqué No. 319.

It is regretted that Sgt. R. Lambert was erroneously reported "PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE." His name should have appeared under "PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION."